POWER

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The Troublemaker

THERE are people who seem to take delight in stirring up trouble.

Sometimes the play for selfish gain is obvious, but often their baleful activities seem to be motivated by nothing more than inborn cussedness.

They are like the fellows who goad the two best friends in the school into a quarrel just to see them fight.

Again they may think that they will gain by being able to fish in troubled waters. There may be more chance for advancement in a disrupted organization especially if somebody who is ahead can be got in bad.

The consequent disorganization and impairment of efficiency, the discontent and enmity, wounded feelings and broken friendships make up a stupendous cost for whatever satisfaction or advantage they get out of it.

And I don't know that I ever saw it do anybody any permanent good.

There are plenty of things in every plant, in every club or society or other group that are not as they might better be, but there are better ways of fixing them than by stirring up discontent and personal bitterness.

Those the even tenor of whose ways are disturbed by the troublemaker rarely end by becoming his friends even if he convinces them that they have a grievance.

And he whose purpose in life seems to be to disturb the orderly progress of affairs is likely to find the occasion of another grouch when somebody who has been dispensing sunshine and good cheer and has been helpful in keeping things moving smoothly and efficiently is chosen over him for preferment and advancement.

F. R. Low

EDITORIALS

Electron Tube In Power Supply

ELECTRON TUBES that a few years ago were part of a squealing radio set now give promise of practically revolutionizing electric power applications and transmission. Already they have many industrial applications, such as in automatic control of elevators, relaying devices, the control of industrial processes, switching devices, lighting control. The electron tubes have great possibilities as rectifiers for converting alternating current into direct current, and vice versa, a necessary characteristic to any practical high-voltage direct-current transmission system. One type, known commercially as Thyratron, is available in sizes for the power supply to five-horsepower two hundred and thirty-volt motors. At the recent Midwest Power Engineering Conference in Chicago, C. W. Stone, of the General Electric Company, referred to progress in the development of banks of tubes for three hundred amperes at fifteen thousand volts for direct-current power transmission.

A practical high-voltage direct-current power-transmission system has long been the dream of electrical engineers; several have been devised, one or two of which were tried commercially, without success. The electron tube promises to solve this problem and others in high-voltage transmission. They are simple in operation and can be easily controlled. The ease with which their voltage can be regulated permits of their use to interrupt the power flow in case of line trouble, thus eliminating a large part of the expensive switching equipment required on alternating-current systems.

In a direct-current system of transmission many of the objectionable effects found in alternating-current disappear. Insulation problems are simplified, and the power that may be transmitted over a given line may be much greater than for an alternating-current system. The large concentration of power into a fault on alternating-current systems would not occur with the direct-current system proposed. These and many other advantages will follow high-voltage, direct-current power transmission.

Although all the problems of power generation and transmission are not solved by this system, the fact that so much has been accomplished in so short a time augurs well for the future. Probably it will be some time before the high-voltage, direct-current system becomes a general substitute for alternating current. However, in the low-voltage field the development of electron tubes has advanced to where they provide the engineer with a new solution to many problems in power application and control.

Federal Government Vs. Private Enterprise

AMONG the general objectives in the Platform for American Business, and fundamental in the planning of sound business development, is one of greatest importance to the power field—"Encouragement of Private Initiative and Responsibility vs. Extension of Governmental Activity."

The extent to which private initiative is being encroached upon is little suspected by many and deserves review.

It has long been a source of dissatisfaction among our shipbuilders that they should be placed in competition with the federal government in the building of naval vessels, and if all the cost of navy-yard built ships were charged against them it is a practical certainty that their prices would suffer greatly in comparison with privately built vessels. The opinion is ventured that every important economic or strategic argument by the proponents of government-built ships can be answered successfully or an equally satisfactory alternative suggested which will permit transferring all work in this class to private yards without sacrifice to the integrity of the republic. Politics or politicians are not included in this consideration.

The United States Reclamation Service is another offender, although not in the same way. It does not actually build its equipment, but it makes its own designs of parts such as sluice gates and discharge valves for hydraulic power projects, and lets its contracts to bidders who are not always competent or experienced enough to properly estimate their costs.

It is a matter of record that experienced hydraulic machinery builders can seldom bid low enough to secure

this class of work, and some of those who have secured such business have finished the work at a loss.

If bidders were allowed to quote upon their own designs for equipment which experience has shown to be suited to the duty, the Reclamation Service would get proper machinery and the hydro-power machinery builder could better afford to maintain a competent designing force and private initiative would receive its legitimate reward.

But a short time ago the United States Navy requested a substantial appropriation of Congress for the manufacture of diesel engines and included a request for $500,000 for the purchase of European diesel engines for experimental purposes. A United States Congressman, F. A. Britten, actually made the statement that American diesel engine manufacturers had "fallen down." Aside from the fact that this has been emphatically denied on the floor of the House by Representative Cochran, and there is no basis in fact for the original statment, one may very properly ask why the navy should not spend its $500,000 helping diesel manufacturers at home. This would be a really constructive thing to do and would have the immediate virtue of aiding private initiative and the employment of men as well.

The most recent effort of government to extend its activity was concluded with the President's veto of the Muscle Shoals bill. Had it become law, the government would have gone into the business of making fertilizer, and of operating a public utility in competition with its own citizens, upon the prosperity of whom the government itself depends.

Business men and individuals are deeply affected by these tendencies of government to enter into competition with the hand that feeds it. Government can not do business with the efficiency of private enterprise. Because one's personal life may not directly contact with these affairs, his prosperity is none the less definitely tied into the support and advancement of a sound Platform for American Business, of which the encouragement of private initiative and responsibility vs. the extension of governmental activity, is a plank of special significance.

Model Tests Reduce Cost Of Hydro Plants

ALTHOUGH a great deal is known about the science of hydraulics, engineering experience and knowledge have not attained that state where the action of water can be predicted under all conditions. Therefore, where there is doubt, hydraulic designs should be checked by model tests. Experience has shown that generally such tests are not an added project expense, but lead to a material reduction in costs. On a project that went into operation recently it is estimated that tests made on models of the development saved one hundred thousand dollars in construction costs. Moreover the design is now correct, which it would not have been without the model test. On a large project now building, tests made on models have shown that if the plant had been constructed as originally designed serious operating difficulties would have been encountered. These probably would have required expensive reconstruction.

Proper design cannot be over-emphasized in hydroelectric plants. They are of such a character that mistakes in design are generally difficult and expensive to remedy. These errors, if not corrected, frequently cause excessive maintenance and loss of efficiency. In a large water-power plant operating at a good load factor the loss of a fraction of one per cent in efficiency may amount to more in a year than the whole cost of a model test to insure correct design.

While model tests of hydro plant designs are essentially a check on actual operation, and of increased output and reduced maintenance costs after they go into service, they also offer great possibilities of cost reduction during construction.

Why Air Agitation In Can Ice?

IS THERE any economic justification for air agitation of can ice during freezing? Quite true, the public first received its training in food preservation by using either natural or distilled water ice, both of which were fairly transparent. But the idea that ice water must be distilled is no longer prevalent; raw water is employed almost universally. Why not eliminate the popular belief that ice must be clear?

Part of this educational work has been completed already by the manufacturers of household refrigerating machines, who find that the user is so thrilled with the little ice cubes that their cloudiness is forgotten.

There is no sane reason why ice should be clear, although the concentration of salts may require the removal of the core water. The cost of agitation air is not great, probably less than a cent a ton of ice for operating charges, but the investment is considerable and the increase in freezing time and operating trouble justify the elimination of all agitation even though the ice becomes cloudy. It is questionable if the average user would notice the difference.

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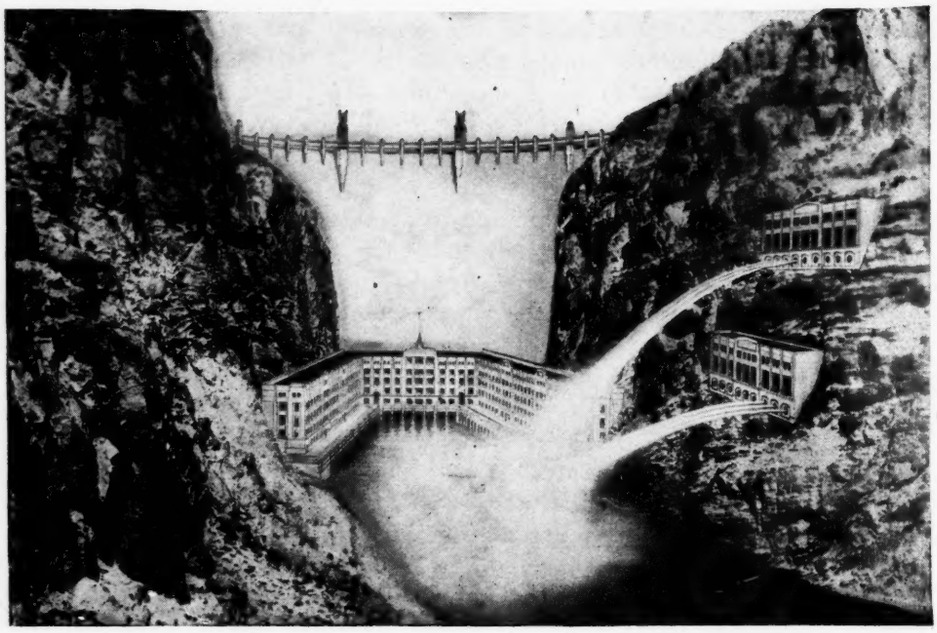
POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**



As the down-stream side of Hoover Dam will look when completed. The canyon-wall outlet works in the right-hand side of the canyon are duplicated on the other side but are not shown in the picture. The power house is on each side of the river just below the dam

Construction Starts Soon on

HOOVER DAM

After nearly ten years of effort by the federal government and other agencies, actual construction on the Hoover Dam project, formerly known as Boulder Dam, is about to begin. The contract for its construction was let on March 11. The project will be constructed in Black Canyon, on the Colorado River, and will comprise a dam, 730-ft. high, that will form a storage reservoir of 30,500,000 acre-ft., with a power plant of about 1,000,000 hp. installed capacity

WORK is soon to be started on the Hoover Dam project on the Colorado River. Incidentally, it will be just 400 years from the time that white man first saw this river until he will have succeeded in bringing it under control. It was in 1536 that Francisco de Ulloa reached the mouth of the river. If present plans carry through, in 1936 Hoover Dam will be ready to control the floods on this river.

Although power development of about 1,000,000 hp. is involved in this project, it is nevertheless a water-supply and river-control undertaking. The river from its mouth, in the Gulf of California, to the head waters of the Green River, in Wyoming, is 1,750 mi. long. Its drainage area of 244,000 sq.mi. includes seven states and a part of Mexico (see map Fig. 1). The annual discharge is about 17,500,000 acre-ft., supplied from the different tributaries approximately as indicated in the table.

The country through which the Colorado River flows is largely arid, but about 7,000,000 acres of land can be irrigated from its waters, of which more than 2,500,000 acres are now under cultivation. Each state and the part of Mexico in the river's basin have farms irrigated from its waters or tributaries.

Southern California, with more than 2,000,000 population, is turning its attention to this river as the most desirable source of a water supply. Los Angeles and the Metropolitan Water District of Southern California have plans under way to take 1,000,000,000 gal. per day from the river below the dam. This water will be pumped against a head of over 1,500 ft. and will require over 400,000 hp. to do the pumping, which will be supplied from the Hoover Dam plant.

Floods on the river have long been a menace to those living in its lower basin. The northern part of the river's drainage area is in the mountainous regions of Wyoming, Utah and Colorado, at elevations of 4,000 to 8,000 ft. When the snow melts in the mountain, the lower river reaches flood stages of approximately 250,000 sec.-ft. At low flow the discharge in the lower reaches is as low as 1,200 sec.-ft. To control the river during high water and prevent it from inundating the farms

in Yuma and the Imperial Valley requires maintaining over 70 mi. of leeves. From the foregoing it is evident that although power generation at Hoover Dam may be large the benefits resulting from flood control and providing water supply are of even greater importance.

The many conflicting interests in this river have made the problem of its control a complex one. Before work could be started on the project of which Hoover Dam is to be a part it was necessary that the seven Colorado River Basin states reach an agreement. In 1922, Herbert Hoover, then Secretary of Commerce, was appointed by President Harding as federal chairman of the Colorado River Commission, created jointly by Congress and the seven states bordering the river. The purpose of this commission was to work out a comprehensive plan for the development of the river and make recommendations to Congress. An agreement was reached and a compact signed which was submitted to the federal government and to the respective states for ratification.

This treaty divided the states into two groups, Utah, Wyoming, Colorado and New Mexico comprising the

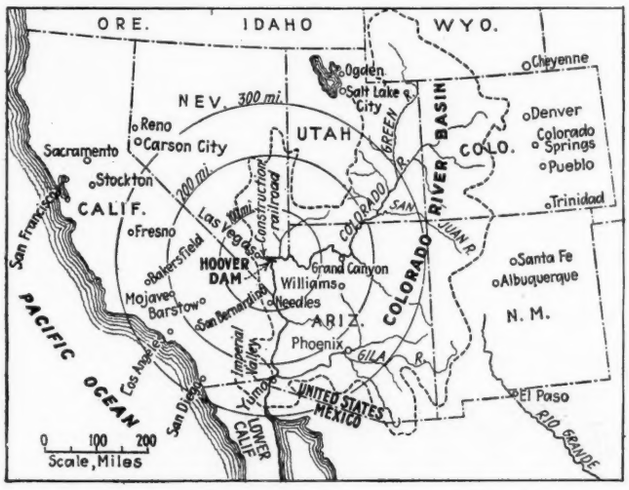


Fig. 1—Map showing the Colorado River Basin and the location of the Hoover Dam project

upper group, and California, Nevada and Arizona comprising the lower. The division of water was based on an average yearly discharge of the river in excess of 16,000,000 acre-ft. To each group was allotted 7,500,000 acre-ft., with the states in the lower group having the right to increase their consumption by 1,000,000 acre-ft. if necessary. This compact did not take from any state the right to regulate the use of waters entirely within its borders.

Six of the states ratified the compact, but Arizona refused and has not done so up to the present. In December, 1928, Congress passed and President Coolidge signed the bill authorizing the federal government to build a high dam in Black Canyon on the Colorado River. The bill empowered the Secretary of the Treasury to advance to the Colorado River Dam fund amounts not to exceed $165,000,000, $25,000,000 of which was to be for flood control. No work was to start within a six-month period unless all the states in the basin ratified the Colorado River compact; but after six months six of the states, one of which must be California, could ratify the compact. The bill requested California, Arizona and Nevada to enter into an agreement dividing the 7,500,000 acre-ft., apportioned annually to the lower basin, so that Arizona would receive 2,800,000 acre-ft. for exclusive beneficial consumption in perpetuity, Nevada to have 300,000 acre-ft., and California's share not to exceed 4,400,000 acre-ft. In the event of a surplus over 7,500,000 acre-ft. it was to be divided equally between California and Arizona. The bill gave Arizona exclusive beneficial use of the Gila River and its tributaries within its borders. The Secretary of the Interior, at his discretion, could enter into contracts for lease of the power. Before work could be started on the dam and power house, contracts had to be made for the power, large enough to repay in 50 years the money spent by the government, plus 4 per cent interest, less the $25,000,000 for flood control.

DISCHARGE OF COLORADO RIVER TRIBUTARIES

Rivers	Drainage Area, Sq. Mile	Per Cent Drainage Area	Annual Discharge, Acre-Ft.	Per Cent Discharge
Green	44,000	18	5,510,000	32
Upper Colorado	26,000	11	6,940,000	40
San Juan	26,000	11	2,500,000	14
Gila	57,000	23	1,070,000	6
Other Areas	91,000	37	1,560,000	8

Contracts for the power were signed in April of last year underwriting the entire power capacity of the plant. The contracts were made between the city of Los Angeles, the Southern California Edison Company and other southern California power companies and the Metropolitan Water District of Southern California, on the one hand, and the United States government on the other. According to the contracts, the federal government agrees to install the power-generating machinery.

Rates to Be Paid for Power

The two lessees are obligated to pay a rental that in fifty years will amortize the cost of the machinery with interest at 4 per cent, but they agree to pay that total in ten annual payments and to keep all machinery in first-class repair and to take care of all replacements. Title to the machinery as well as to the dam and power house structure is to remain with the government. The government sells to the lessees only the falling water.

Each lessee will operate the machinery required to supply its own allocation. The city of Los Angeles will operate the machinery necessary to supply the Metropolitan Water District and the smaller municipalities of southern California and such power as is taken by the states of Arizona and Nevada. The Southern California Edison Company will operate the machinery for generating the power allocated to the power companies. Under the contract, the Secretary of the Interior will appoint a director who will have general supervision over the Hoover Dam power plant. This director will be on the government payroll.

The rate to be paid by the two lesees, the city of Los Angeles and the Edison company, is 1.63 mills per kilowatt-hour for primary power and 0.5 mill for secondary power. A charge at the switchboard to allottees that are not lessees, and therefore are not operating power units, will be 2 mills per kilowatt-hour for primary power and 0.9 mill for secondary power. The total annual generation when the project is completed is estimated at 4,200,000,000 kw.-hr. of firm power and 1,500,000,000 kw.-hr. of secondary power. At the end of fifteen years from the date of the contract, and every ten years thereafter, the rates for firm and secondary energy are to be adjusted to meet the competitive price at distributing points or competitive centers.

The life of the lease of the city of Los Angeles will be 50 yr. and will begin when generator capacity to sup-

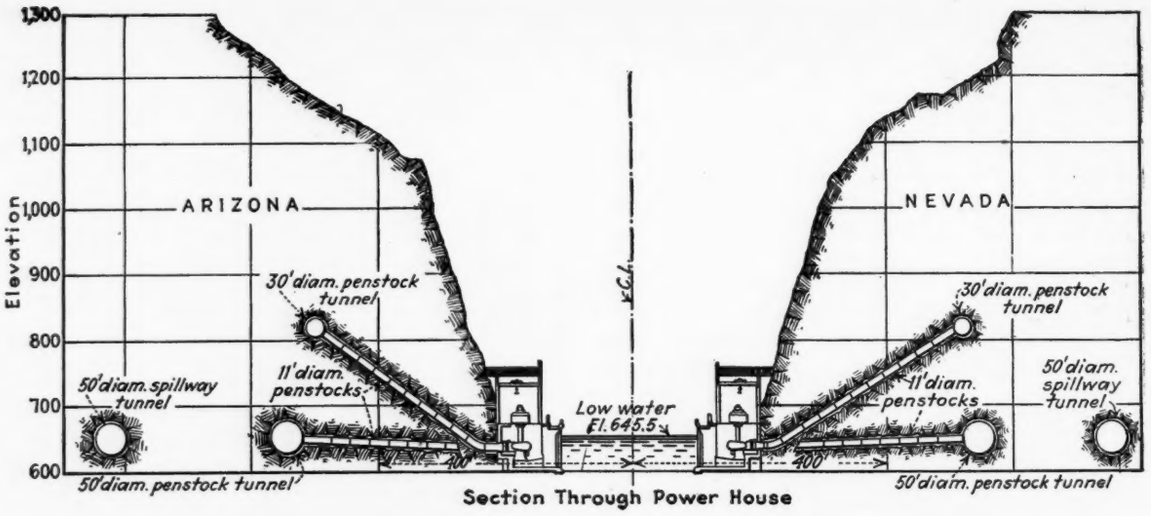


FIG. 2—CROSS-SECTION THROUGH BLACK CANYON AND THE POWER HOUSE

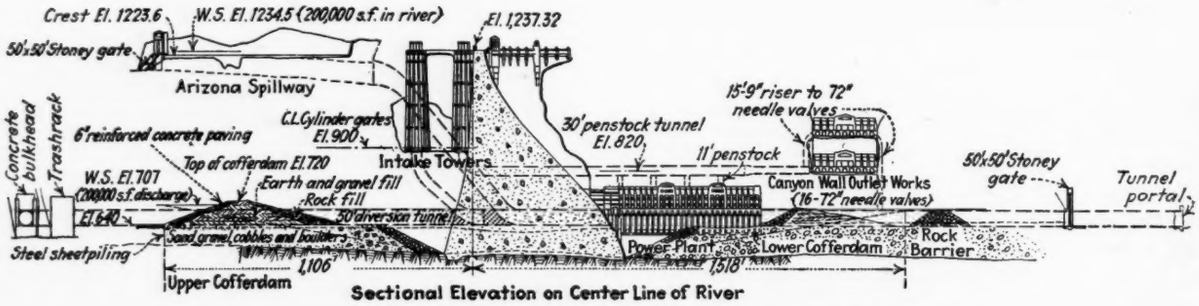


FIG. 3—SECTION ELEVATION THROUGH THE PROJECT ON THE CENTER LINE OF THE RIVER

The dam is 730 ft. high from the lowest point in bed-rock foundation to its crest. It will be 650 ft. thick at its base and will have a crest length of 1,180 ft. A total of 3,400,000 cu.yd. of concrete will be required in its construction. Water can be bypassed around the power house through thirty-two 72-in. needle valves in the canyon wall outlet works on each side of the river, and four 72-in. needle valves in each of the two 50-ft. penstock tunnels, one in each canyon wall.

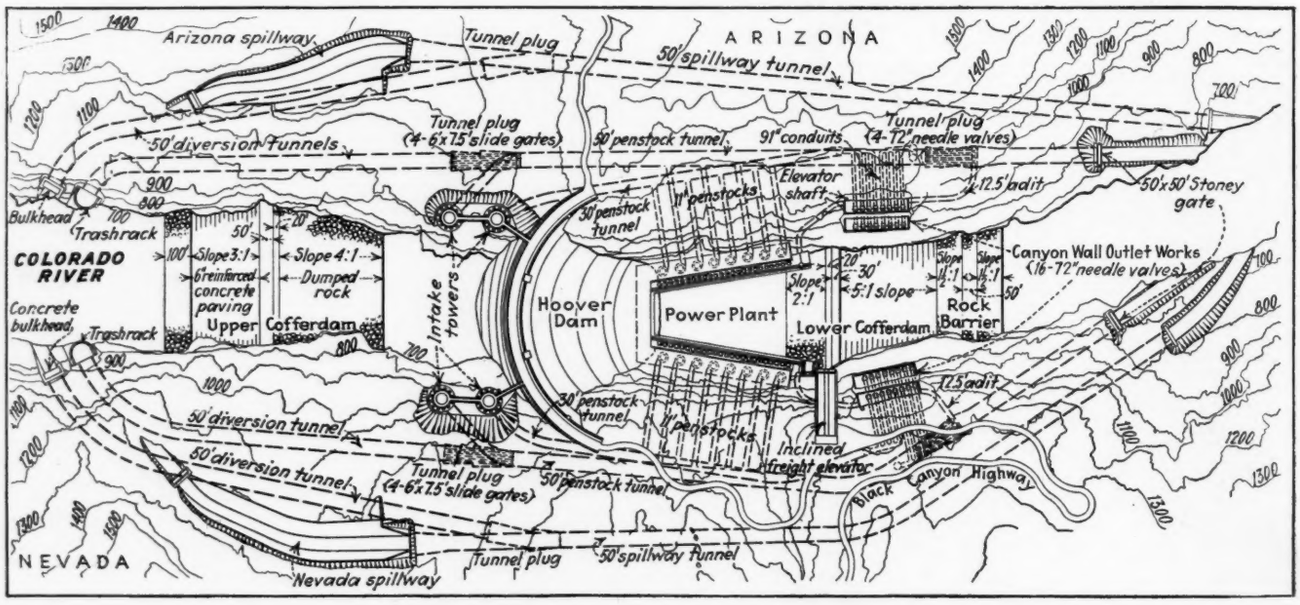


FIG. 4—PLAN OF THE BLACK CANYON, SHOWING THE LOCATION OF THE HOOVER DAM PROJECT

Each section of the power house will have 8 units, the total installed capacity being about 1,000,000 hp. Each unit will be supplied with water through an 11-ft. penstock tunneled in the canyon wall. On each side of the river, four of these penstocks will connect to a 30-ft. penstock tunnel and the other four will connect to the 50-ft. penstock tunnel. Control of the water to these tunnels will be by 31-ft. cylindrical gates, in the bottom of four intake towers, 350 ft. high.

ply 1,250,000,000 kw-hr. per year has been installed and is ready to operate. The Metropolitan Water District lease will become operative a year later, and its life will be 49 yr. The lease of the Southern California Edison Company will not be operative until 3 yr. after the city takes its first power. This provision was made in order to give the company time to find a market for the power that the city will surrender to it when Hoover Dam power is available. This provision makes the Edison contract run for 47 yr. Under the provisions of the contract, each lessee will have the same absorption period. They will be required to take up 55 per cent of their allocation the first year, 70 per cent the second year, 85 per cent the third year and 100 per cent the fourth year.

The Metropolitan Water District has the right to 36 per cent of the power under its contract, plus the first call on all secondary power, plus the first call on such of the 18 per cent allocated to Nevada and 18 per cent allocated to Arizona that those states do not use.

The city of Los Angeles gets 13 per cent and the smaller municipalities receive 6 per cent of the total power. The Edison company is lessee for 9 per cent of the total power, which amount is allocated to it, the Southern Sierras Power Company, the Los Angeles Gas & Electric Corporation and the San Diego Consolidated Gas & Electric Company.

Of whatever power is not being used by Nevada and Arizona or by the Metropolitan Water District, the city of Los Angeles is to have half and the Edison company half. In addition to the power feature of the contract with the government, the Metropolitan Water District has signed a contract under which it will pay the government 25c. an acre-ft. a year as a water-storage charge.

Appropriation Made for Project

After 9 yr. of debate, Congress, on June 27, 1930, removed the last obstacle, except court interference by Arizona, in the way of constructing the Hoover Dam project by appropriating $10,660,000 for starting the work. Construction was started on Sept. 17 and the name of the project was changed from Boulder Dam to Hoover Dam. On Jan. 4 plans and specifications for the project were ready and bids were opened March 4 with a combination of Western construction firms, the Six Companies, Inc., of San Francisco, the lowest bidder on the general contract for the project. Dr. Elwood Mead, Commissioner of Reclamation, has recommended that this company's bid of $48,890,995.50 be accepted by Ray Lyman Wilbur, Secretary of the Interior. The Six Companies, Inc., include the Utah Construction Company, San Francisco and Ogden; Henry J. Kaiser and W. A. Bethel & Company, San Francisco; McDonald & Kahn, Ltd., San Francisco; Morris, Knudsen & Company, Boise, Idaho; J. F. Shea Company, Portland, Ore.; the Pacific Bridge Company, Portland. It is expected that the contract will be awarded about April 1.

The plans and specifications call for a dam, power plant and appurtenant works in Black Canyon. This site is about 20 mi. downstream from Boulder Canyon, one of the sites considered for the dam, and 185 mi. below Grand Canyon National Park boundary. The nearest town to the project is Las Vegas, Nev., 25 mi. northwest of the development, on the Union Pacific Railroad. A railroad is being built from Las Vegas to Summit, the site of a proposed permanent town to be built about 8 miles from the development by the government. An extension of the railroad and a construction highway will run from there to the canyon rim above the damsite. An inclined freight elevator in the Nevada Canyon wall will be used to lower equipment and material into the canyon.

The general plans of the project are shown in Figs. 2 to 4. Before work can be started on the dam four diversion concrete-lined tunnels, each 50 ft. in diameter and about 4,000 ft. long, must be driven on each side of the river. According to the plans, it will require until October, 1933, to complete these tunnels and to carry the work on the cofferdams to a point where excavation of the damsite can be started.

Rock-and-Earth Cofferdams

Both cofferdams will be rock-and-earth embankments thrown across the river. On account of the possible turbulence of the water entering the tunnels, the upstream face of the upper cofferdam will have a rock blanket over which will be a reinforced concrete paving, sealed in at the toe with sheet-steel piling. When the discharge of the river is 200,000 sec.-ft. through the tunnels the top of the cofferdam will be 13 ft. above the water's surface. This discharge is only slightly less than the highest flood occurring during the last 20 yr. A rock barrier will protect the downstream face of the lower cofferdam.

The dam will be of massive concrete arch-gravity construction, 730 ft. above the lowest point of foundation bed rock, about twice as high as any other dam built. It will be 650 ft. thick at the base and will have a crest length of 1,180 ft. The crest will be 45 ft. wide and will form a bridge for the Black Canyon highway. A total of 3,400,000 cu.yd. of concrete will be used in the dam's construction. To provide for expansion and contraction the concrete will be built up in columns. The heat due to the concrete's setting will be reduced by forcing cooled water through 2-in. pipes imbedded in the structure. After the concrete is cooled the joints between the columns will be grouted full. A 700-ton refrigerating plant will be required to supply the water for cooling the concrete.

Reservoir 115 Miles Long

A reservoir 115 mi. long and having a maximum capacity of 30,500,000 acre-ft. will be formed above the dam. This is almost double the mean annual discharge, 15,700,000 acre-ft., of the river at the dam. Of the total capacity of the reservoir, 9,500,000 acre-ft. will be used for flood control and the remainder, 21,000,000 acre-ft., will be used for power generation, irrigation, water supply and silt retention. The reservoir will act as a settling basin for the silt carried by the water. However, with the construction of other dams upstream, it is estimated that the silt will not decrease the capacity of the reservoir more than 3,000,000 acre-ft. in 50 years.

The power plant will be a U-shaped structure immediately downstream from the dam, with one wing of the "U" on each side of the river. Each wing of the building will house six or eight units, and the aggregate capacity of the ultimate installation will be approximately 1,000,000 hp. The hydraulic and electrical machinery, equipment and wiring will be installed by the government. The contractor will be required to place all the concrete around such machinery installed before the completion of the dam.

The two diversion tunnels farthest away from the river will be used for a spillway discharge in the com-

pleted job. Two spillways will be constructed, one on each side of the river. Each will consist, in downstream order, of a 50x50-ft. Stoney gate, a concrete ogee overflow crest about 700 ft. long, a reinforced concrete-lined open channel and a 50-ft. diameter concrete-lined inclined tunnel through which the water will pass to the outer diversion tunnel. The two outer diversion tunnels will be plugged with concrete immediately upstream from their junction with the inclined spillway tunnels.

Outlet works, similar in design, will be constructed on both sides of the river above the dam. These works will consist of two separate systems, each being regulated by a cylinder gate in the bottom of an intake tower 350 ft. high. The two towers will be about 165 ft. apart in a direction parallel with the sides of the river. The system regulated from the upstream tower, in downstream order, will consist of the tower with a cylindrical gate 31 ft. in diameter discharging into a 30-ft. diameter inclined tunnel connecting with the diversion tunnel nearest the river. The diversion tunnels will be plugged where the inclined tunnels join them. In each plug will be four 6x7.5-ft. sliding gates. These tunnels will have a second plug below the canyon wall outlet works. In each of the plugs will be four 6-ft. needle valves. Near the plugs' upstream end a connection will be made to eight 6-ft. needle valves in the canyon wall outlet works. At the lower end of each of the inner diversion tunnels will be installed a 50-ft. Stoney gate. These tunnels will serve the dual purpose of control works and penstocks. From each tunnel four 11-ft. penstocks will lead to each section of the power house.

The outlet works regulated by the downstream intake towers will comprise a tower with a 31-ft. cylindrical gate discharging into a 30-ft. horizontal penstock tunnel leading to eight discharge valves in the canyon wall control valve houses. Four 11-ft. penstocks will also lead from these tunnels to each section of the power house. The lower and upper canyon wall outlet gate and needle valves on each side of the river are housed in separate buildings, as can be seen in Fig. 3

The government will furnish practically all the equipment that becomes a permanent part of the project, including cement, reinforcing bars, rails, metal pipe and fittings, conduit lining, castings and plate, steel linings for the power penstocks, gates and hoists, needle valves, traveling cranes, power machinery and control equipment. All the material furnished by the government will be delivered to the contractor f.o.b. cars at the delivery yard near Boulder City. The contractor will haul all the equipment from the point of delivery to the job and will furnish all material not a permanent part of the project.

The government reserves the right to commence power generation in the plant any time after water above the dam has been stored to elevation 900. It is expected that four units will be placed in operation about twenty months before the dam is completed. Concrete work on the dam is planned to be completed in August, 1937.

The engineering of the project is being done by the Bureau of Reclamation under direction of Dr. Elwood Mead, Commissioner of Reclamation. Raymond F. Walter is chief engineer of the bureau; John L. Savage is chief designing engineer; and Walker R. Young is construction engineer. Frank T. Crowe, Boise, Idaho, will be general superintendent in charge of construction. Drawings used in this article were prepared from similar ones in the plans and specifications issued by the bureau for the letting of the construction contract.

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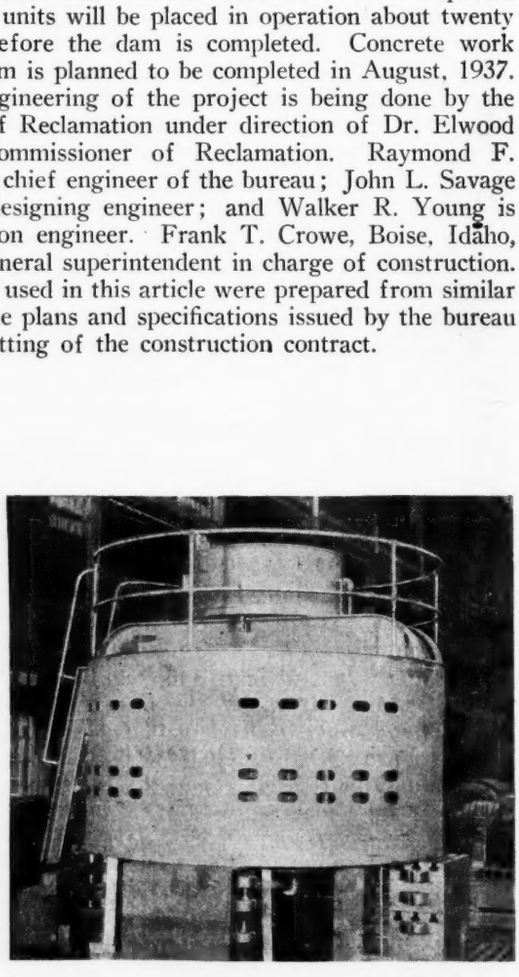
Ford Installs 700-Hp. Vertical Two-Speed Synchronous Motors

THERE has recently been shipped to the Ford Motor Company, River Rouge plant, four vertical synchronous motors by the Westinghouse Electric & Manufacturing Company. These motors will drive propeller-type pumps designed to pump large quantities of water at low head. They are designed as three-speed machines, which is unusual synchronous-motor construction. However, the present machines are built for two-speed operation, with provisions made for adding an additional speed unit later. The capacity of the present motors is 700 hp. at 277 r.p.m. and 350 hp. at 138 r.p.m., changes in speed being obtained by changing the rotor and stator connections. The future units will be rated 300 hp. at 200 r.p.m. and will be separate stators and rotors installed in a space provided for them on the present frames and shafts.

Because of the characteristics of the pumps the motors were designed with extremely high pull-in torques. The starting sequence is automatic, with the motor control interlocked with the pump-valve motor control. Selector push-button control gives the desired operating speed. The motors are always started on the low-speed winding, regardless of the operating speed desired. If high or intermediate speed is desired transfer to the correct winding connections is automatically made at the proper time. Full-line voltage starting is used, the various steps in control operation being accomplished through definite-time relays. Because of a possible emergency operating condition the motors were designed to hold in step with a 25 per cent voltage drop when another unit is being started.



Two-speed vertical synchronous motor drives propeller type pumps

Pennsylvania State College Has New Power Plant

By G. G. HOLLINS

Mechanical Engineer
The J. G. White Engineering Corp.

THE POWER PLANT recently completed at Pennsylvania State College, State College, Pa., has been designed to harmonize with the other campus buildings. Service furnished by the plant includes steam for heating at 5 to 10 lb. gage, steam at 60 lb. for general service, electricity and compressed air, the latter principally to supply an air-lift well.

Two turbine-generators, one of 750 kw. and one of 1,250 kw., are installed. The smaller machine was in service in the old plant and has been equipped with new nozzles and readjusted to operate at 275 lb. The boiler room contains four 600-hp. Stirling boilers with superheaters and Taylor underfeed stokers.

Coal is received on a railroad siding and is raised to a bunker over the boilers by a skip hoist. From the bunker it is delivered to the stokers by a traveling weigh larry. A skip hoist and overhead bunker are also provided for the ashes. For outside appearance the coal and ash skip hoists and the ash bunker have been kept entirely inside the building.

The turbines operate non-condensing against a pressure of 5 to 10 lb. gage, but may be readily changed to single-extraction condensing operation. The present load does not warrant condensing operation and the use of heating steam takes the greater part of the exhaust.

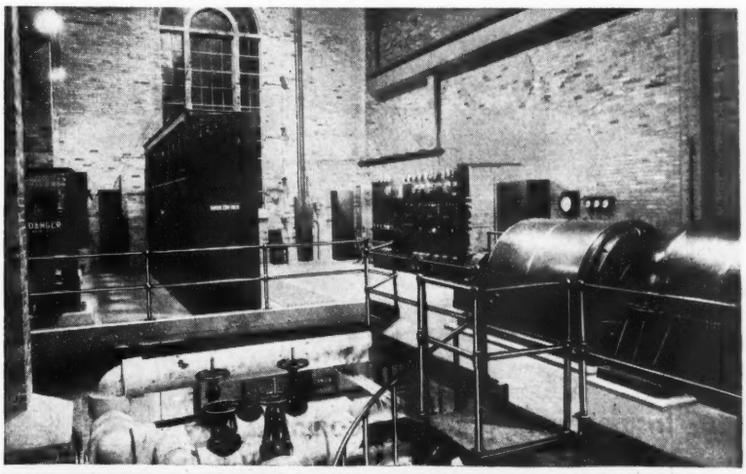
Electrical connection with the public utility system is provided, the exchange of power being regulated so as to maintain the best heat balance. When growth of the electrical load makes it desirable to operate partly condensing, additional blading and extraction valves can be put into the turbines and condensers installed with cooling pond or tower.

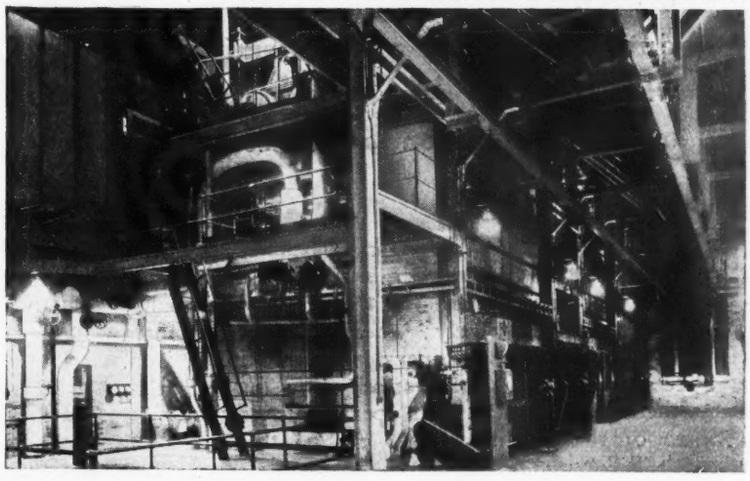
There is space for an additional turbine generator, and the boiler room has space for over twice the present capacity. The building was made larger than at present necessary to avoid the use of temporary walls, which would have detracted from the appearance. Also, the extra floor space can be used to advantage for experimental work.

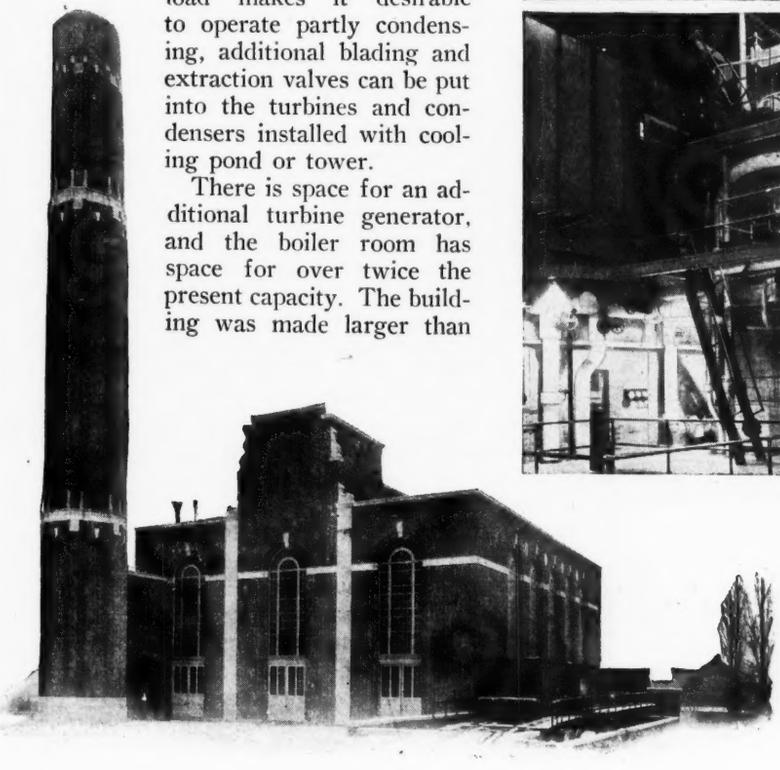
The electrical control board is made of stretcher level steel panels, all indicating instruments being of the triplex type, requiring no ammeter or voltmeter switches. A vibrating-type voltage regulator is provided for each unit.

The whole distribution system, steam and electric, is underground, the main pipe lines being in a tunnel which extends over a large part of the campus. Branch steam lines are in vetrified tile and 1,000 ft. of new tunnel was constructed to connect the new plant with the existing tunnel system.

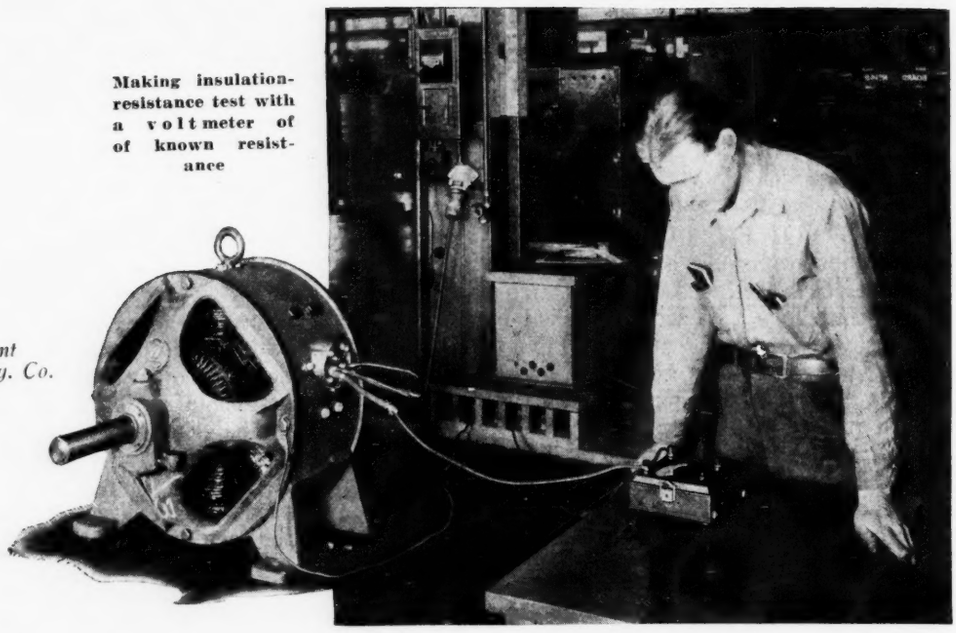
The plant was designed and the construction supervised by the J. G. White Engineering Corp., and the achitect was Charles Z. Klauder, of Philadeplhia.







The turbine-generators are supplied by four 600-hp. Stirling boilers



Making insulation-resistance test with a voltmeter of of known resistance

By J. L. RYLANDER
Motor Engineering Department
Westinghouse Electric & Mfg. Co.

What Is GOOD INSULATION on Electrical

Insulation failure is the common evil of all electrical equipment. The author outlines methods of determining when cleaning and drying of electrical machines' insulation are necessary

IN THE operation of electrical machinery there is always uncertainty about the insulation. It may be satisfactory one day and fail the next. The quality of insulation varies widely; whereas, the other main elements of electrical machinery, such as copper, iron, and steel, have very small variations in qualities that affect their performance under operating conditions.

Some of the conditions that change the insulation strength are temporary; others are permanent. The absorption of moisture in insulating material is usually only temporary, but is objectionable. Acids and alkalies in liquid form are even worse than ordinary moisture.

Many machines have parts, such as commutators and collectors, which cannot be inclosed in solid insulation. Where air is the insulation between live parts or to ground, an accumulation of conducting dust may bridge across the air spaces and short circuit the insulator. It is not necessary that a motor operate where the surrounding atmosphere contains conducting material to cause a condition dangerous to commutator and collector-ring insulation, because dust worn from the machines brushes and commutator or collector rings is conducting material. Any machine with excessive brush wear needs attention and observation to guard against insulation breakdown.

The deteriorating influences previously mentioned are nearly always present to some extent in electrical machines. The gathering of dust is to a considerable degree a cumulative process. Some of the dust penetrates into crevices that cannot be blown out and some becomes embedded in the varnish surfaces. The absorption of moisture may occur when a motor stands idle for a day or more in a damp location. When a motor or generator is in this condition the operator may well hesitate about starting it up and consider if he should dry out the windings. To dry out a winding means expense, trouble and a loss of time. On the other hand, if the winding is not dried out it may fail when starting up or shortly afterward. For this reason it is desirable to have some means of helping to decide whether the insulation is in satisfactory condition for operation.

There are two common methods of testing insulation. One is to apply a given voltage to see if the insulation has sufficient dielectric strength. This practice has one disadvantage. If the insulation does not stand the applied voltage it will puncture and will require repairing. The other common test is to measure the insulation resistance. This can be done with comparative safety to the insulation unless too high a voltage is applied. One method is to use the line voltage of direct-current machines and measure, with a high-resistance voltmeter, the voltage

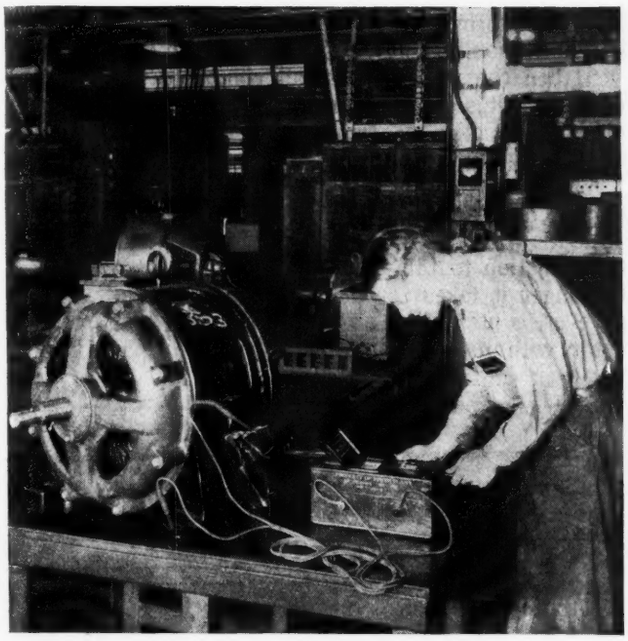


Fig. 1—Insulation-resistance test being made with a megohm meter

Machines?

drop through the insulation when one line terminal is connected to the frame and the other to the winding. From this reading the insulation resistance is figured from the formula $R = r\left(\frac{E-V}{V}\right)$, where R = the insulation resistance of the winding in ohms, r = ohms resistance of the voltmeter (about 60,000 for a 600-volt meter), E = line volts, and V = voltmeter reading in volts.

Another method that is convenient and that can be used for any winding whether alternating or direct current is to use a megohm meter. The operation is simple. One of the meter's leads is connected to the winding and the other is connected to the iron frame or core, as in Fig. 1. When the crank of the meter is turned the insulation resistance is shown by the pointer on a calibrated scale. One precaution that should be observed is to choose a meter whose voltage is not too high. The 1,000-volt instrument is unsatisfactory for many cases, but the 500-volt type is the most commonly used and is best for most applications.

Insulation Resistance

Insulation measurements can be used to good advantage in many applications if the readings are taken at periodic intervals in a systematic manner and all pertinent data recorded. However, if anyone thinks that it is possible to set a value that will definitely determine whether the insulation is safe, he will be disappointed after measuring a number of machines at different times. Duplicate machines will often show no similarity in regard to insulation resistance. The curves *A*, *B* and *C* in Fig. 3 show the probable reason.

Every machine will have insulation resistance values that vary from very low to very high if one measurement is made when the insulation is saturated with moisture and other measurements taken after the insulation is dried out. An induction motor having 100,000,000 ohms insulation resistance when thoroughly dry may have as low as 10,000 ohms when saturated with moisture. An armature will show similar change in resistance values if the insulation creepage surfaces on the commutator become embedded with carbon dust in the varnish surface even when a small amount of moisture is present. Furthermore, some motors will operate satisfactorily when the insulation has absorbed considerable moisture, whereas others will fail because of a much smaller quantity.

The type of insulation, the voltage stress and its dielectric strength are determining factors on how much moisture a winding may absorb before it will probably fail. Some materials may show a high insulation resistance and have a low dielectric strength, while others will have a relatively low insulation resistance and a good dielectric strength. Dielectric strength is the more important quality.

To show the difficulties of setting an insulation value as being the dividing line between what is safe and what will fail, the records on three machines are given: A 5-hp., 220-volt motor that had already failed by grounding had no dielectric strength, but had an insulation resistance of 125,000 ohms. A 25-hp., 440-volt motor was sprayed with water at regular intervals, and its resistance would get as low as 10,000 ohms, yet it did not break down at normal voltage. A large motor failed that had an insulation resistance of 4,000,000 ohms at the time of failure. The failure occurred in the coil ends, not in the slot.

Insulation-resistance measurements are valuable in determining the presence of moisture and conducting materials. Nevertheless, these measurements do not def-

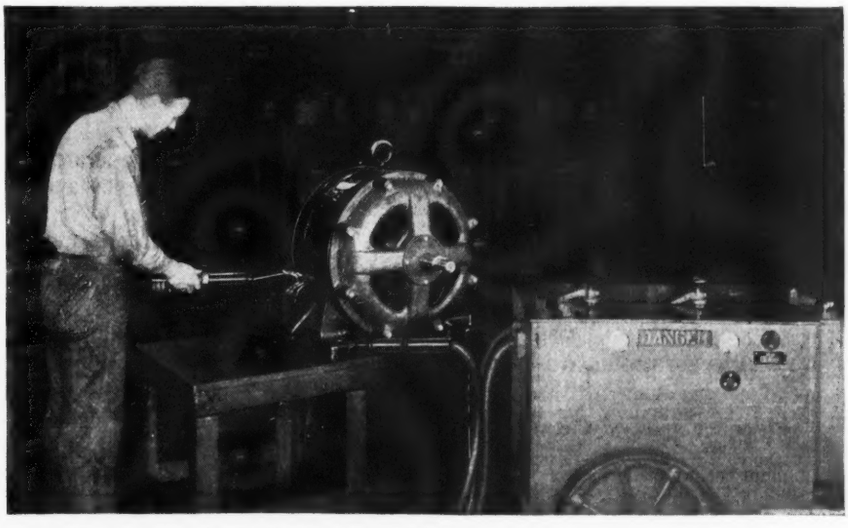


Fig. 2—Applying a high-potential test to an induction motor's stator winding

initely indicate whether the insulation will stand up or fail if the machine is operated. Tables I and II show the effect of moisture on insulation resistance of two motors which had been intentionally sprayed with water.

Table III gives the values of insulation resistance on a number of machines of different sizes, different voltages, and of various types.

The Effect of Moisture

When motors stand idle they absorb moisture. The insulation resistance decreases rapidly when the insulation absorbs even a small amount of moisture. The quantity of moisture absorbed depends upon the humidity of the air, the length of time, the kind of insulation, and whether it is sealed with varnish. Fig. 4 shows the effect of relative humidity and time.

All insulating materials absorb moisture. This is contrary to the common belief that varnish coatings are absolutely moisture proof. Of all the insulating materials, mica splittings are least affected by moisture. Varnish coatings absorb moisture and also allow moisture to penetrate through them, but the quantity and rate of penetration are slow compared to most materials that are untreated. The rate of absorption of moisture in untreated cotton tapes or papers is hundreds of times faster than in a varnish film. The untreated materials will become filled with moisture in a few seconds like a blotter absorbs ink. A varnish film will require from a week to a month to become saturated with moisture, and even then the amount is small compared to untreated material. This great difference accounts for the almost universal practice of treating all absorbent insulation materials with varnish or other impregnating compounds.

When motors are used in damp locations and stand idle for days a sufficient amount of moisture may penetrate the windings, sealed with coats of varnish, to cause the insulation to fail. The heavier the coat of varnish the longer it takes for moisture to penetrate it. This, however, is not always an advantage. For example, if a motor with its windings covered with heavy coats of varnish stands idle in a damp place for a month it will have absorbed considerable moisture. When the motor is started the moisture cannot be driven off except with great difficulty. This entrapped moisture may or may not cause failure, depending on a number of factors, such as the type of insulating materials, their quantity, the voltage stress on them, and also the voltage stress and insulation in the winding between adjacent turns.

TABLE I—INSULATION RESISTANCE OF A 5-HP., 220-VOLT INDUCTION MOTOR

	Ohms
At 20 deg. C., winding dry	100,000,000
At 20 deg. C., after ½ hr. spraying with water	30,000,000
At 70 deg. C., after 2½-hr. run	56,000
At 70 deg. C., sprayed while hot, stood idle all night, then run 2½ hr.	20,000

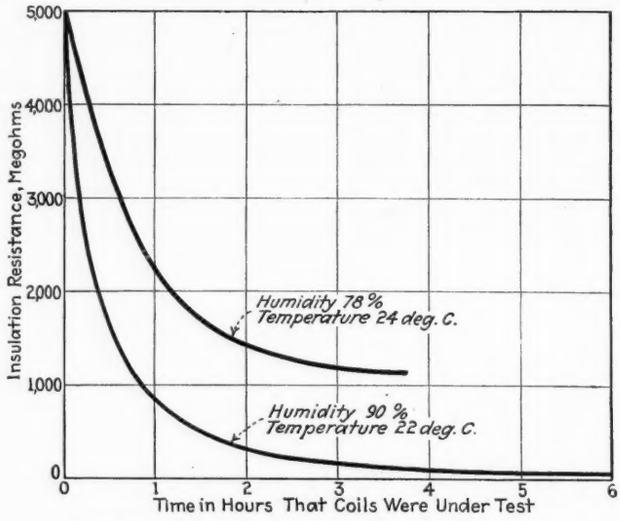


Fig. 4—Effects of humidity on insulation resistance of armature coils with mica insulation

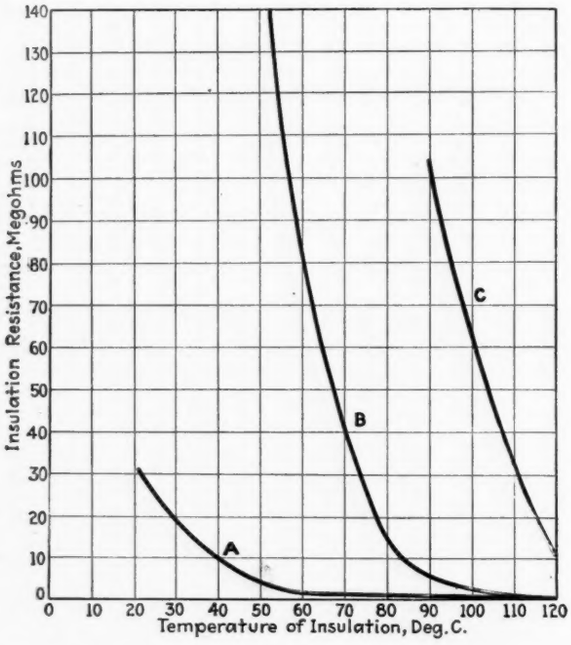


FIG. 3—CURVES SHOWING EFFECTS OF TEMPERATURE ON INSULATION

Curve *A* is for insulation that has considerable volatile matter. Curve *B* is for insulation containing an average amount of volatile matter. Curve *C* is for insulation in which there is very little volatile matter. It is evident from these curves that the amount of volatile matter in insulating materials has a marked effect upon its resistance with changes of temperature. Materials high in volatile matter have low resistance at low initial temperatures, where low-volatile materials have high insulation resistance at low temperatures. The insulation resistance of all three shows a decided tendency to decrease as the temperature is increased.

Table IV shows the insulation resistance of a 5-hp. induction motor which had absorbed considerable moisture and that was sealed in by adding two coats of baking varnish. It will be noticed that long continued baking did not drive out all of the moisture. The windings were dried continuously for five days at 105 deg. C.

The Effect of Temperature

Temperature has a considerable effect on insulation resistance and is second only to moisture in causing a change in its values. Other things being equal, insulation resistance decreases as the temperature increases.

TABLE II—INSULATION RESISTANCE OF A 7½ HP., 230-VOLT DIRECT-CURRENT MOTOR

	Ohms
At 20 deg. C., winding dry	19,000,000
At 20 deg. C., one hour after spraying with water	10,000
At 70 deg. C., after above spraying and running at full load for four hours	1,750,000

This can be seen by referring to Table III. The general effect is shown in Fig. 3. It is apparent that when insulation resistance values are recorded or discussed the approximate temperature of the winding should always be given.

TABLE III—INSULATION VALUES OF DIFFERENT TYPES OF ELECTRICAL MACHINES AS DETERMINED BY TESTS

Hp.	Kind of Machine (New and Dry) Volts	Type	Insulation Resistance in Megohms Stator 20°C	Stator Hot	Rotor 20°C	Rotor Hot
1	220/440	Ind. motor	100	5	...	.....
2	220/440	Ind. motor	100	5	...	.....
3	220/440	Ind. motor	100	5	...	.....
10	220/440	Ind. motor	100	5	...	.....
15	220/440	Ind. motor	100	5	...	.....
350	550	Ind. motor	O.C.[1]	50	O.C.	100
125	2,200	Ind. motor	O.C.	100	...	17
200	4,150	Ind. motor	O.C.	...	40	.....
250	6,300	Ind. motor	O.C.	...	35	.....
1,500	6,600	Ind. motor	...	50	...	6
3,500	6,600	Ind. motor	100	35	8	0.8
4,000	6,600	Ind. motor	75	25	O.C.	50
6,250	480	Syn. motor	O.C.	20	100	50
350	2,200	Syn. motor	O.C.	75	100	50
2,500	2,200	Syn. motor	100	...	100	.....
5,000	4,000	Syn. motor	O.C.	40	20	0.4
800	6,600	Syn. motor	O.C.	100	100	60
2,030	6,600	Syn. motor	100	45	10	1.5
2,100	6,600	Syn. motor	O.C.	...	100	.....
5,000	6,600	Syn. motor	O.C	100	15	4
5,760	6,600	Syn. motor	O.C.	20	15	1.5
13,620	6,600	Syn. motor	O.C.	13	15	0.05
18,750	13,000	Tur. gen	100	50	50	20
450	550	D.-C. gen.	100	8	12	0.18
450	550	D.-C. gen.	100	40	19	8
35	600	Rwy. arm.	...	...	100	3
300	480	Rotary conv.	O.C.	75	100	25

[1]Very high insulation resistance as indicated by infinity calibration on the meter's scale.

As a machine increases in physical size, the insulation resistance decreases, on account of the greater area of conducting surface. Likewise, an individual armature coil or small piece of insulation has an insulation resistance that is many times that of a complete winding. Also, as the thickness of insulation increases, as in high-voltage machines, the insulation resistance increases accordingly. If a winding is connected to parts, like commutators, collectors, connectors, or ventilated coils, where there is exposed copper, the insulation resistance will be much less than when the parts are completely covered with insulation. The insulation resistance of exposed parts is usually controlled by the surface creepage from the exposed copper to the nearest iron. Here a small amount of moisture has a large effect. If there is an accumulation of dust the effect is even greater. When both moisture and conducting dust are present the moisture bridges across from particle to particle and causes the resistance to be so low as to be dangerous to the insulation.

Using Insulation Resistance As a Guide

To use resistance as a guide to the condition of electrical-apparatus insulation it is necessary to know what its insulation resistance is under a given set of conditions. If comparable data are available from previous readings on the particular motor or generator, the variables such as size, kind and quantity of insulation are eliminated. Even the great variable, temperature, is eliminated if the records include measurements through a range of temperatures.

TABLE IV—INSULATION RESISTANCE OF A MOTOR IN WHICH MOISTURE WAS SEALED IN WITH VARNISH

Time	Insulation Resistance
Thursday afternoon.....	60 megohms at 20 deg. C.
Friday morning.....	6 megohms at 105 deg. C.
Saturday morning.....	1 megohm at 105 deg. C.
Saturday afternoon.....	0.4 megohms at 105 deg. C.
Sunday morning.....	0.6 megohms at 105 deg. C.
Monday morning.....	1 megohm at 105 deg. C.
Monday afternoon.....	3 megohms at 105 deg. C.
Tuesday morning.....	2 megohms at 105 deg. C.

Record cards should include the machine's rating, the insulation-resistance values and the approximate temperature of the windings at the time of measurements. It is advisable to have readings with the windings at the average air temperature and also at the temperature attained at its usual load. Readings should note times when the machine stood idle during damp weather. It is preferable to rely on hot values rather than cold, as there is less variation in the hot condition.

The A.I.E.E. standardization rules state that the insulation resistance of a dry clean machine at its operating temperature should be not less than that given by the formula:

$$\textit{Insulation Resistance in Megohms} = \frac{\textit{Rated Voltage}}{\textit{Rating in kva.} + 1{,}000}$$

It should be noted that this is for dry machines at their operating temperature. No definite rule can be set for machines whose insulation is not dry or nearly so. Motors operating in damp locations will have much lower values than those determined by the above formula, but, as mentioned previously, machines may fail which have much higher values than these.

The Road to Safety

Insulation-resistance measurements can be likened to the signs along a highway. These signs show the condition of the road, but do not tell which automobiles can proceed safely and whether they have to put on tire chains to do so. Putting on tire chains would correspond to the limited drying out of the insulation. Just as the condition of the tires, the length of wheel base, and other factors make one automobile act differently from others, so does the general design of the winding and the insulation, and the safety factor allow one winding to operate satisfactorily and another to fail under the same moisture conditions.

It is evident that insulation-resistance measurements will always record the presence of moisture in insulation and give an idea of its magnitude, and also record the presence of excessive conducting dust on the windings. However, insulation resistance does not determine the dielectric strength of the insulation, although in general the dielectric strength increases with increase in resistance and decreases with decrease in resistance. From the advantages mentioned, checking the condition of the insulation at regular periods and in emergency conditions should prove a decided advantage. Fortunately modern insulation has been so developed and protected by varnish and other treatments that relatively few breakdowns occur under normal conditions.

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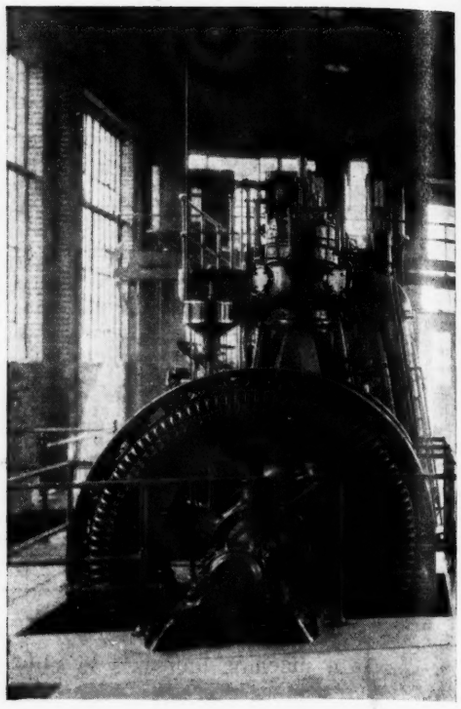
Installation of equipment to carry out, over a period of years, tests to determine the effect of fogs on insulators has been begun by the Southern California Edison Company, Ltd., at its El Segundo substation, on the sea coast near Los Angeles. R. J. C. Wood, research engineer for the company, is in charge of the tests. Various makes and types of insulators will be utilized on the 66-kva. lines during this new period of experiments, which is a continuation of work which Mr. Wood has been conducting for many years past. Coincident with this installation, although not bearing on the insulator tests, the capacity of the El Segundo station is being increased from 9,000 kva. to 18,000 kva. The increased capacity is required to meet heavier service demands. The station serves a large oil refinery as well as other industrial, agricultural and domestic consumers.



Scheduled maintenance is just as necessary in diesel plants as it is for steam equipment

Scheduled Maintenance Insures Diesel Reliability

By T. A. BURDICK

While chief engineer of a public utility owning a number of diesel stations, the author realized that scheduled maintenance is necessary for both diesel and steam equipment. Some of his ideas are embodied in this article

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ALL OIL ENGINES, as is the case with a steam plant, must be properly maintained if efficient and reliable service is to be obtained, even though some operators feel that the very simplicity of the diesel makes inspection and adjustment almost unnecessary.

Because the diesel ignites the fuel by the heat of compression the compressor pressure must be high enough to raise the temperature of the air above the oil's ignition point, say 800 deg. F. as a minimum. Consequently the compression pressure of a machine should be maintained within ten pounds of the pressure recommended by the engine manufacturer. The probable causes for variation in compression are leaky valves, leaky piston rings, low scavenging pressure, obstructions in the suction lines and increased piston end clearance.

The final compression pressure of a power cylinder is determined by the piston end clearance. The maximum allowable variation for this adjustment should not exceed 0.035 inch.

As the engine is built to burn the fuel at a rate such that the maximum pressure does not exceed a predetermined value, the combustion pressure should be kept within 15 lb. of the recommended full-load pressure. The combustion pressure is affected by the compression pressure, the fuel- or spray-valve conditions, the injection timing, the injection air pressure and the fuel oil characteristics.

The quality of combustion should be good at all times. Incomplete combustion results in a direct fuel loss and causes undue wear and maintenance. A clear exhaust indicates that the temperature of the gases is low, while a poor exhaust is evidenced by smoke and high temperature.

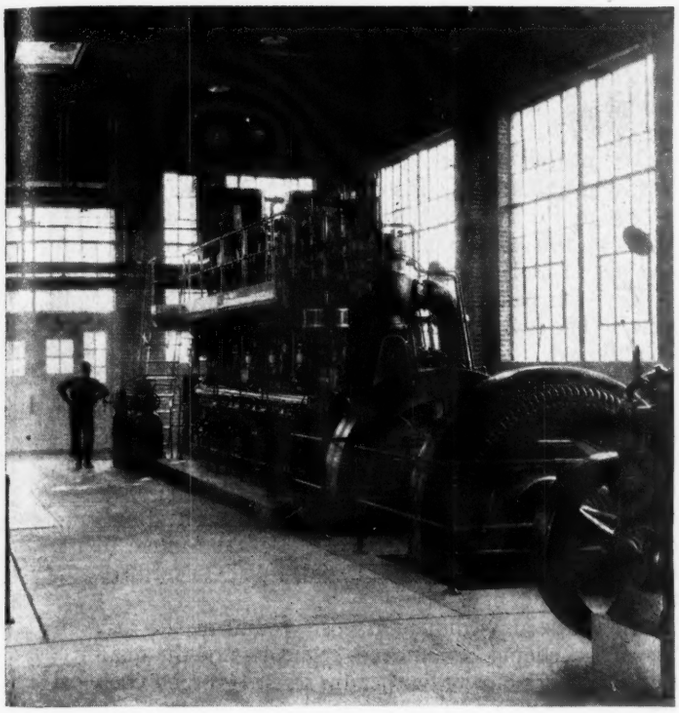
If indicator diagrams are properly taken, they give accurate information as to the condition of combustion in an engine, and the mechanical deficiencies affecting combustion are readily found by taking a series of such diagrams. The engineer should make a monthly indicator-diagram record of the engine, showing the compression pressure, the combustion pressure, the exhaust temperature and the load carried in kilowatts at the time the diagram is taken.

Valve rocker arm roller clearance plays an important part in engine operation and performance. Check this clearance often and keep it absolutely to the standard.

All valves should be kept in condition. It is not a good practice to allow valves to wear sufficiently to make reseating difficult. If valves are leaking, they wear rapidly, and it is not long before it is impossible to recondition them, making a replacement necessary.

Valve lift has much to do with the service that can be expected from a valve and its seat. The recommended lift is one that will give good service. The lift should be checked each time a valve is overhauled and corrected to the recommended amount.

Valve timing can usually be checked with a protractor on the crank web; however, if this is not practical, tram for the crank top center and lay off the flywheel rim in degrees. Corrections for exhaust and air-valve timing should not be made for any variations less than five de-



grees. Always take the average reading from all valves before making an adjustment.

The fuel- or spray-valve timing is extremely important; and much care should be used in its adjustment. The recommended settings should be followed exactly.

Fuel pump settings and adjustments on air-injection machines determine the individual cylinder load, and consequently it has a direct effect on engine steadiness. The adjustment should be carefully checked and all pumps made to deliver equal quantities of fuel to all cylinders.

Fuel pumps on solid-injection machines serve a dual purpose: They measure the quantity and time the delivery of fuel to each individual cylinder. This compound function makes it extremely important that they be accurately adjusted and timed.

The condition of the piston and liner are indicative of the quantity and quality of the lubricating oil used. If the piston rings and liner have a bright surface and the rings are free, a proper amount of suitable oil is being supplied. If the wearing surfaces have a dull grayish appearance and the rings are more or less stuck, the oil is an inferior grade and should be replaced by better oil. Too much lubricating oil, even of good quality, will result in the accumulation of a heavy, gummy deposit on the rings and piston.

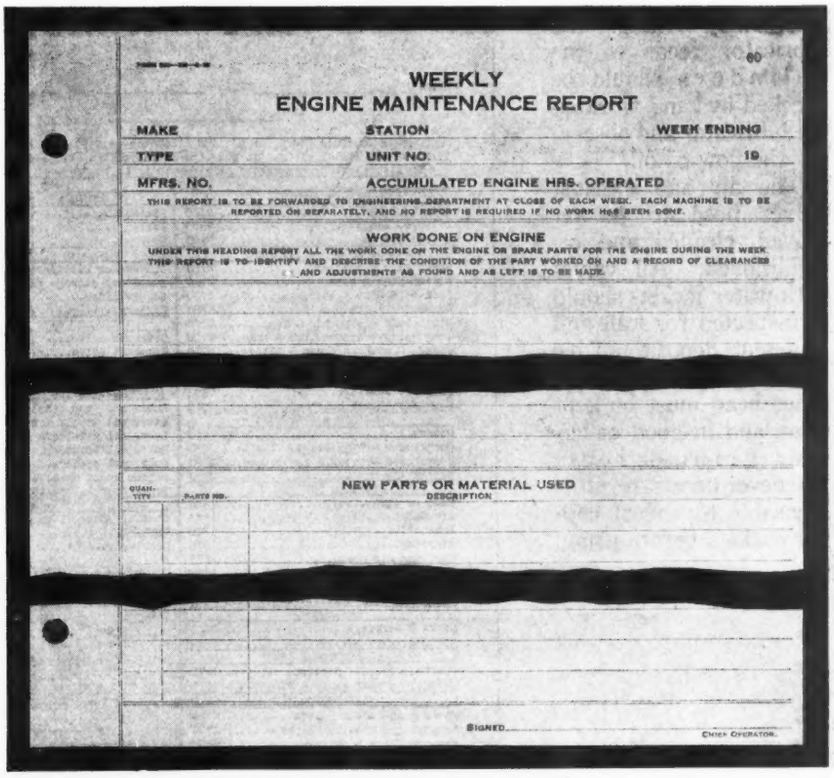
If an engine is operated with poor combustion, as evidenced by a smoky exhaust, a gummy residue will be found on the rings, even if the proper amount of good lubricating oil has been used.

When the pistons are out for inspection, the cylinder lubricators should be worked by hand until oil comes freely from each of the feed holes. Whenever a piston pin has been removed, care must be taken in replacing it so as not to distort the piston. After assembling, it should always be checked for roundness.

Compressor output and efficiency are influenced by the low- and high-stage piston and clearance. These clearances are to be kept at a minimum at all times. Whenever a compressor piston or liner is replaced, check and make sure that the clearances compare closely with those recommended.

It is particularly important to keep the piston rings in first-class condition, for they control the power developed by the engine and the lubrication of the piston and cylinder. If permitted to remain in the engine after blow-by has started, they will cause a loss of power and the piston and cylinder will be scored due to the effect of the hot gases upon the lubricant. Ring condition should be investigated upon the first signs of blow-by. In renewing rings, make certain that they are given the proper side and gap clearance.

Working clearance and the lubrication determine the service that can be obtained from a bearing and its pin. A bearing fitted too loosely will, by repeated pounding, flatten the pin, and the babbitt lining will crack. If the bearing lacks clearance, it will burn out from excessive friction. The variation in adjustment that will give good operating results is very small; therefore, it is important to know the proper clearance, and every effort should be put forth in obtaining and maintaining that clearance. Standard bearing clearances given by the engine builder are correct for machines that are mechanically right and operating under favorable conditions. The factors that change the standard bearing clearances are the grade and



WEEKLY
ENGINE MAINTENANCE REPORT

MAKE | STATION | WEEK ENDING
TYPE | UNIT NO. | 19
MFRS. NO. | ACCUMULATED ENGINE HRS. OPERATED

THIS REPORT IS TO BE FORWARDED TO ENGINEERING DEPARTMENT AT CLOSE OF EACH WEEK. EACH MACHINE IS TO BE REPORTED ON SEPARATELY, AND NO REPORT IS REQUIRED IF NO WORK HAS BEEN DONE.

WORK DONE ON ENGINE

UNDER THIS HEADING REPORT ALL THE WORK DONE ON THE ENGINE OR SPARE PARTS FOR THE ENGINE DURING THE WEEK. THIS REPORT IS TO IDENTIFY AND DESCRIBE THE CONDITION OF THE PART WORKED ON AND A RECORD OF CLEARANCES AND ADJUSTMENTS AS FOUND AND AS LEFT IS TO BE MADE.

NEW PARTS OR MATERIAL USED

QUANTITY | PARTS NO. | DESCRIPTION

SIGNED.....
CHIEF OPERATOR.

Fig. 1—A weekly report should be used to record all maintenance on each engine

quality of the lubricating oil, the condition of pin and bearing, the general mechanical condition of the machine, and the load carried. The maximum change in adjustments to take care of these varying conditions will not exceed 0.004 inch.

The crankshaft alignment is important and should be checked at least once a year. Even though misalignment is not revealed by pounding, it may be so great that the shaft will break in a few weeks' time. The difference in quality of individual bearing lubrication, the variation in quality of bearing metal and the different bearing pressures all have a natural tendency to destroy crankshaft alignment. A close watch should be kept on bearing wear, and if the change in clearance is not uniform on all bearings the shaft alignment should be checked.

Detailed instructions for operation and maintenance of each engine are usually furnished by the manufacturer. These instructions should be strictly adhered to. At the time of inspection or overhaul the important parts should receive careful attention.

Bridge-gage readings and micrometer measurements between the cranks should be taken and recorded. All bearings should be removed, cleaned and repaired and the shaft cleaned and polished. All oil wells and bearing seats should be cleaned. The crankshaft should be rebedded if this is necessary and final bridge-gage readings and records of shaft alignment should be entered on the data book. All bearings should be adjusted to the recommended clearance.

The crossheads, pin bearings and shoes should be removed, cleaned, repaired, refitted and adjusted to the recommended clearances.

The pistons should be pulled, rings removed and the pistons and rings thoroughly cleaned. All burned or scored places on the piston should be polished by stoning.

The cylinders or liners should be cleaned and burned or scored places polished by stoning. The lubricator feeds to the cylinders should be checked by hand-working the lubricator and observing the flow of oil.

The air and exhaust valves need to be removed, cleaned and reconditioned. All valves with water jackets should be inspected for scale and sediment deposit. The valve cage seat in the cylinder head must be kept clean and in good condition; grind or ream whenever necessary. It is advisable to anneal copper gaskets before using.

Do not overlook the governor, which should be inspected for worn slides, bearings and pins. Check the condition of springs and connections. Inspect all lubricating oil feeds for obstruction to flow or stopped passages.

The pistons of packed fuel pumps should be inspected for wear and scores. Pistons that are only slightly worn and scored can be polished and put back in service. In the case of a leaky plunger of a lapped unit, replace both the piston and cylinder bushing. If found hard, worn or dry, the packing should be completely replaced with new. The valves must be removed, cleaned and reconditioned.

In the inspection of the cooling passages in the piston it will be necessary to dismantle the piston. Any scale, carbon or other deposits must be removed. The packing should be inspected, and if found dry, hard or worn, replaced with new rings. The bearings need be inspected for alignment and effectiveness of lubrication and adjusted to the proper clearances. Ball-and-hinge joints, if used on an engine, should be inspected for adjustment, alignment and fit.

Any scale or sediment deposit found at the time of inspection should be removed, regardless of the quantity, removal being effected either by scraping or by chemical treatment with a scale remover.

Do not forget to inspect and test the relief valves to make sure that they are set at the proper pressure and will act at that pressure.

A report similar to that shown in Fig. 1 should be used to make weekly records of all maintenance operations performed on each engine in the plant. If no work has been done on the engine during the week no report need be made. The form provides merely for a memorandum of the actual work accomplished, together with a list of all parts and material used. A copy of this report is to be kept in the plant in a separate file provided for each unit. The form provides also for a notation of the accumulated engine-hours operated at the time the report was made. It is important that this information be inserted, so that the history of the machine may be traced by reference to the maintenance report file, and, when desired, summaries may be prepared showing the relative rapidity of wear on certain parts among the various machines in a plant or in an entire system.

INSPECTION AND MAINTENANCE SCHEDULE
OIL ENGINES

Make _____ H.P. _____ Type _____

This schedule gives the maximum allowable operating hours between inspections of the listed parts. At the time of inspection all cleaning and adjusting consistant with good engine maintenance is to be done.

PART	HOURS
CRANKSHAFT	
Main bearings	7500
Outboard bearing	7500
Thrust bearing	7500
CROSSHEADS, RODS & AUX.SHAFTS	
Crank pins & bearings	3750
Piston pins & bearings	3750
Crosshead pins & bearings	3750
Crosshead shoes & slides	3750
Compressor piston pin & brg.	3750
Compressor crosshead pin & brg.	3750
Compr. crosshead shoes & slides	3750
Vertical shaft bearings	7500
Vertical shaft thrust bearing	7500
Camshaft bearing	7500
Camshaft thrust bearing	7500
PISTONS & CYLINDERS	
Power	3750
Compressor - high stage	3750
Compressor - inter.& low stages	3750
Scavenging pump	3750
CYLINDER HEAD VALVES	
Fuel or spray	1875
Air inlet	1875
Exhaust	1875
Starting	1875
Starting air check	1875
Scavenging valves mechanical	1875
Safety or relief	1875
Fuel try or by-pass	1875
GOVERNOR	
Links & bearings	3750
Springs	3750
COMPRESSOR VALVES	
Compressor suct. & disch.	1875
Scavenging pump suct. & disch.	1875
SCAVENGING SYSTEM	
Ports & automatic valves	3750
Exhaust gas flow regulators	3750
Exhaust ducts & mufflers	7500

PART	HOURS
FUEL PUMPS	
Pistons	1875
Packing	1875
Valves	1875
FUEL OIL SYSTEM	
Filters or strainers	24
Auxiliary storage tanks	3750
Supply lines	3750
Heaters	7500
GEARS OR CHAIN DRIVES	
Governor drive	7500
Camshaft drive	7500
Fuel pump drive	7500
Lubr. pump drive	7500
LUBRICATING SYSTEM	
Lubr. oil pump complete	7500
Lubr. oil supply lines	7500
Lubr. oil strainers or filters.	150
Lubr. oil tanks	7500
Lubr. oil coolers	3750
Engine crank case	3750
Pres. feed lubricator & checks.	3750
PISTON COOLING	
Cooling passages in piston	7500
Packing	7500
Bearings	3750
Ball & hinge joints	3750
SCALE & SEDIMENT DEPOSIT	
Cylinder heads & jackets	1875
Air coolers	1875
Oil coolers	3750
AIR INTAKE SYSTEM	
Air filters	625
Air suction ducts & mufflers	7500
PRESSURE GAUGES	
Air, oil, & water gauges	3750
RELIEF VALVES	
Air & water	3750
Lubr. Oil	3750
Exhaust gas	3750

Fig. 2—Parts should be inspected at regular periods

Welded Power Boilers Covered by New Code Proposal

FUSION-WELDED drums for power boilers are brought a step nearer—and a big step—by the latest publication of the A.S.M.E. Boiler Code Committee. The "Proposed Specifications for Fusion Welding," printed in the March number of *Mechanical Engineering*, embody the best features of previous proposals plus a new classification of extreme importance to present and prospective fabricators of welded vessels. Of equal significance is the inclusion of welded drums for power boilers among Class 1 vessels, requiring Grade A welding. If and when this code is authorized, welded boiler drums, long debated, will bocame a reality.

The latest proposal of the code committee may reasonably expect a cordial reception. During the past twelve months there have been many opportunities to discuss the proposals printed in *Mechanical Engineering* (March and December, 1930). Leaders in the welding industry have brought their constructive criticisms item by item. And the committee has labored incessantly to combine the best thought from all sources into a code that would be of utmost service to the field without letting down the bars against unsafe construction.

So much has been published that the average reader may find it hard to identify the various proposals and to distinguish between their applications to boilers and to other pressure vessels. A brief review will clear up this confusion.

Where Matters Stand Today

The March, 1930, proposal covered boilers only. That of December referred to pressure vessels in general. In preparing the latter, however, the code committee had boilers in mind as well as the highest class of unfired pressure vessels.

The latest proposal makes a few minor changes in the pressure vessel proposal of December, 1930, and then adopts it *in toto* for Class 1 vessels, including boiler drums. The proposal of March, 1930, is thereby wiped out, although many of its features are retained.

We have, therefore, to consider only the latest proposal, remembering that most of the December proposal is incorporated in it under specifications for Class 1 vessels and Grade A welding.

Rigid Requirements for Class 1 Vessels

The feeling of many that the specifications of December, 1930, were too severe would appear justified if all vessels were required to meet them. That this was not the intent of the committee is now clear. Aside from boilers, these severe requirements apply only to vessels containing noxious, poisonous or inflammable liquids or gases. Some of the requirements for these vessels may be briefly indicated here without any attempt at completeness.

A diameter limitation ranging from 60 in. to 96 in., according to construction, is imposed. Elaborate provision is made for the preparation and testing of sample welds. Bend and specific gravity tests are included.

The X-ray receives exceptional recognition as a tool of engineering. X-ray prints of every portion of the main joints must be submitted to the inspector, along with a description of the radiographic technique employed. General stress relief by heating all over is compulsory.

Clearly these elaborate precautions would be an intolerable burden on manufacturers of vessels for less severe service. Moreover they would be unnecessary.

An outstanding feature of the latest proposal is its provision for other types of service.

Classes 2 and 3 for Less Severe Service

Three classes of vessels are included in the present code. Class 1 has already been discussed. Classes 2 and 3 do not include vessels containing dangerous liquids or gases. Any other vessels with walls not more than 1¼ in. fall in Class 2, except that they may be included in Class 3 where the wall thickness is not over ⅜ in. and where gases and liquids are stored at temperatures below their boiling point at atmospheric pressure.

ALLOWABLE STRESSES AT DIFFERENT TEMPERATURES

Class	Grade of Welding	Longitudinal joint efficiency Per Cent	Minimum tensile strength, Lb. per Sq. In.	Temperature, Degrees F. 60	650	700	750	800	850	900	950
1	A	90	55,000	9900	9900	9900	9000	7200	6100	4950	3600
			50,000	9000	9000	9000	8200	6600	5450	4350	3250
			45,000	8100	8100	8100	7400	5900	4900	3900	2900
2	B	80	55,000	8800	8800	8800	8000	6400	5400	4400	3200
			50,000	8000	8000	8000	7300	5800	4850	3850	2900
			45,000	7200	7200	7200	6550	5250	4350	3450	2550
	C	70	55,000	7700	7700	7700	7000	5600	4750	3850	2800
			50,000	7000	7000	7000	6350	5100	4250	3400	2500
			45,000	6300	6300	6300	5700	4550	3800	3000	2300
3	D Butt-welded joints	60	55,000	6600[1]	..	..	..	..	..	..	..
			50,000	6000[1]	..	..	..	..	..	..	..
			45,000	5400[1]	..	..	..	..	..	..	..
	D Lap-welded joints	50	55,000	5500[1]	..	..	..	..	..	..	..
			50,000	5000[1]	..	..	..	..	..	..	..
			45,000	4500[1]	..	..	..	..	..	..	..

[1] These values may be employed for all conditions for which Class 3 vessels may be used.

A valuable feature of the proposed code is its recognition of the affect of temperature on strength. The accompanying table shows the provision here made.

In all cases work must be done by a qualified welder and stamped with his number. General stress relief by heating to 1,100 deg. F. is required always for Class 1 vessels and for thick-walled vessels of Class 2. Elaborate inspection requirements are laid down.

The hydrostatic test prescribed for vessels not stress-relieved gives a stress in the longitudinal joints 1½ times normal. With it goes the hammer test.

Four Grades of Welding

The requirements for Grade A welding have already been outlined: Grade B is the same, with X-ray and stress relief (sometimes) eliminated and the ductility requirement reduced from 30 to 20 per cent, measured by the pre-bend test.

Grade C applies to welding that cannot be done in a horizontal position. Here the required ductility is 12 per cent.

Grade D welding can be done by any manufacturer after qualifying his process by test specimens.

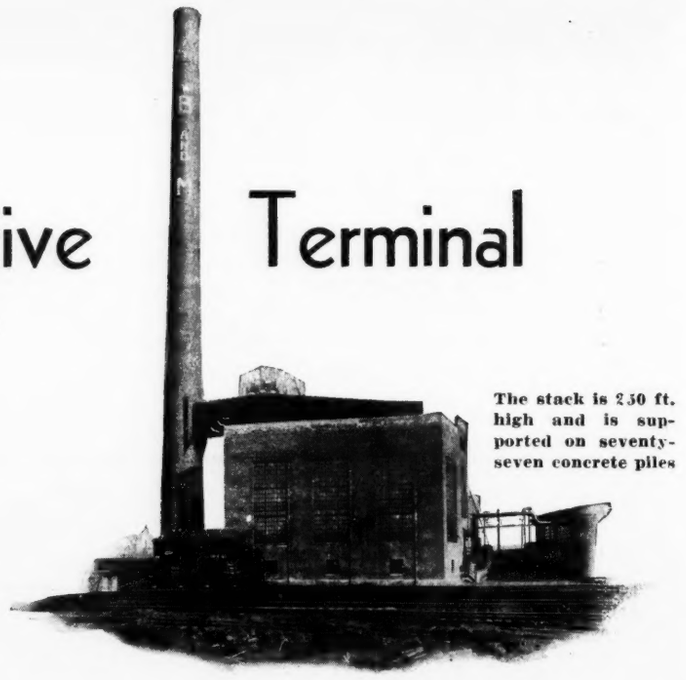
It is clear that the authorization of this proposed code would at once open up the field of boiler welding to manufacturers properly equipped. It is known that several are ready to go ahead. At the same time the code would provide for the immense and growing field of unfired pressure vessels.

Boiler Plant for a Locomotive Terminal

By L. C. WINSHIP

Electrical Engineer
Boston & Maine Railroad

Pulverized fuel firing, absence of partition between boiler and engine room, and iron grating engine room floor are features of boiler house serving the new Boston locomotive terminal of the Boston & Maine Railroad



The stack is 250 ft. high and is supported on seventy-seven concrete piles

THE NEW Boston locomotive terminal of the Boston & Maine Railroad has as a major item a fifty-stall modern engine house. To serve this engine house with steam for direct steaming of locomotives, steam for coach and building heating, hot water for locomotive boiler washing and filling, and compressed air for shop yard and signal facilities, a 250-lb. pulverized-fuel-fired boiler plant has been installed.

The building is of brick and steel construction, approximately 90 ft. square on the ground floor level and rising in two bays to heights of 39 and 65 ft. In the boiler room there are two main floor levels. The lower level is slightly below that of the combustion chamber floor, and the upper level, or firing aisle, is slightly below the pulverized-coal burners. The three 7,500-sq.ft. bent-tube boilers are in a line, with the firing aisle approximately in the center of the building.

The air compressors and pumps are on the other side of the firing aisle, about 8 ft. below it, the difference in level resulting from the necessity of keeping the engine foundations and building heights as low as possible. There is no partition between the two sections of the plant, it being possible for the engineer to stand in the firing aisle and observe the operation of the entire plant. A mezzanine floor over the pumps carries a deaërating feed-water heater, aftercooler for the air compressors, and locomotive washing and filling system auxiliaries. The floor section around the compressors and pumps, and at the mezzanine level, is entirely metal grating, which provides easy access to pipe lines beneath. Extending out over the pumps from the boiler operating floor level is a grating platform which serves as a small office. The station instrument panel is located at this point.

Fuel is delivered over a special spur track which provides storage space for four cars. Protection from the weather at the hopper location is afforded by a steel structure built as a lean-to and covering a track length of about 35 ft. Coal is elevated from the track hopper by a skip hoist that discharges into a bin from which fuel is fed to a crusher and magnetic separator. The hoist is designed to make about 35 trips an hour, with a load of three-quarters of a ton. This makes it possible to unload a car of coal in three hours. Coal is distributed to the boiler room bunker, which extends the full length of the boiler room, by a belt conveyor. The bunker is made of copper-bearing steel, and has a capacity of 200 tons, which is approximately sufficient for two days of winter operation.

Coal from the bunker is delivered to three spouts spaced along the bunker to leave little dead coal area. These spouts terminate in three automatic scale units which deliver coal to unit pulverizers.

There are three unit pulverizers of combined impact and attrition type, each of 5,000-lb. per hour capacity. They are driven by 60-hp. steam turbines. Magnetic separators, provided with the units, are energized from a small motor-generator set. The pulverizers are in front of the boiler on the boiler operating floor level, and they deliver fuel to the burners through 10-in. diameter iron pipes arranged so that coal may be fed to two burners from one pulverizer. This offers protection against equipment failure and provides additional capacity by making it possible to operate a boiler at loads above the rating of one pulverizer. This cross-connection also makes possible the use of fuel from a section of the bunker not immediately above the boiler in service.

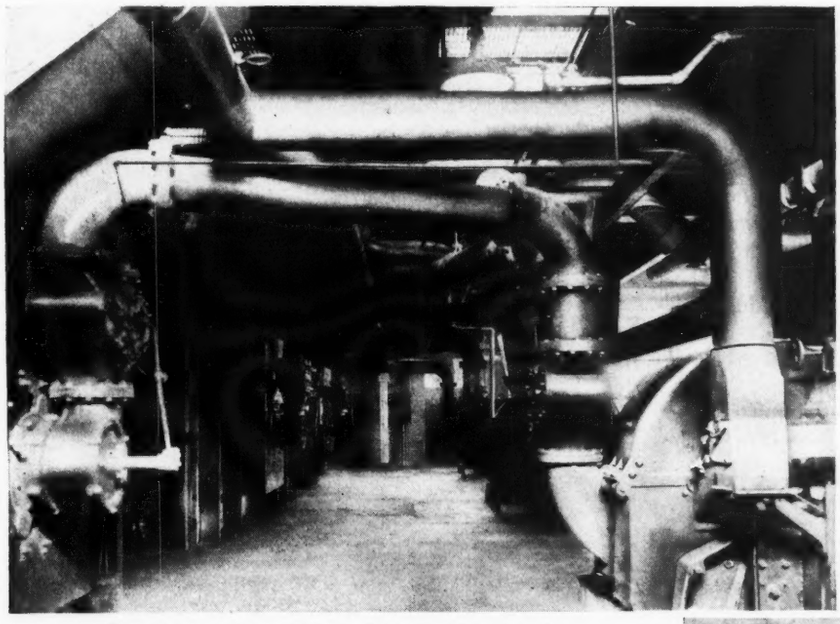
Each furnace is equipped with one pressure-type pulverized-fuel burner, located in the center of the front wall about 12 ft. above the floor of the combustion chamber. Primary air, used to carry the coal from the unit pulverizer to the burner, is drawn both from the boiler room and the combustion chamber. The amount taken from the furnace is varied to meet the fuel condition with respect to moisture, being increased with wet coal to produce drying action during pulverizing.

Secondary air is drawn through the air-cooled furnace setting by a 40-hp. turbine-driven fan mounted on a floor level above the pulverizer. There is one fan unit for each furnace. The secondary air is delivered to a windbox

surrounding the burner, and is directed by control vanes so as to effectively break up the fuel stream.

The combustion chamber is designed to provide for the liberation of 15,000 B.t.u. per cubic foot of furnace volume. It is approximately 12 ft. wide, 16 ft. deep and 17 ft. high to the center line of the mud drum. The firebrick lining at the rear, on the side and at the front above the burner is steel-supported and air-cooled. Tile construction provides natural ventilation for the floor of the furnace.

Doors are provided in the front and rear walls through which ash can be hoed into a small hopper car operated on depressed tracks. The hopper car, when loaded, is pushed to the platform of a hydraulic elevator located at the end of the building, and there is raised to the level of an unloading platform, from which the ash is dumped into an open-top railroad car. Because of the fineness of the ash, the removal space has been made dust-tight.



Firing aisle, showing how coal piping is arranged so that each unit mill can serve two burners

The three vertical bent-tube boilers are designed to deliver steam at 250 lb. pressure and 100 deg. superheat. They are of the four-drum type, the drums ranging from 36 to 48 in. in diameter. Each boiler has 391 $3\frac{1}{4}$-in. tubes. The superheater units are suspended from headers above the boiler.

The steam piping is arranged around two main headers placed across the plant above and between the second and third boilers. The lines from the boilers and those to the various turbines, pumps and air compressors are looped and valved in such a way as to make it possible to cut out practically every valve for maintenance work without interfering with plant operation. Three large lines lead out of the plant, one for the direct steaming of locomotives, a second for coach and building heating and a third for low-pressure heating in the engine house, store room and office. This low-pressure heating system will absorb all of the available exhaust during the winter.

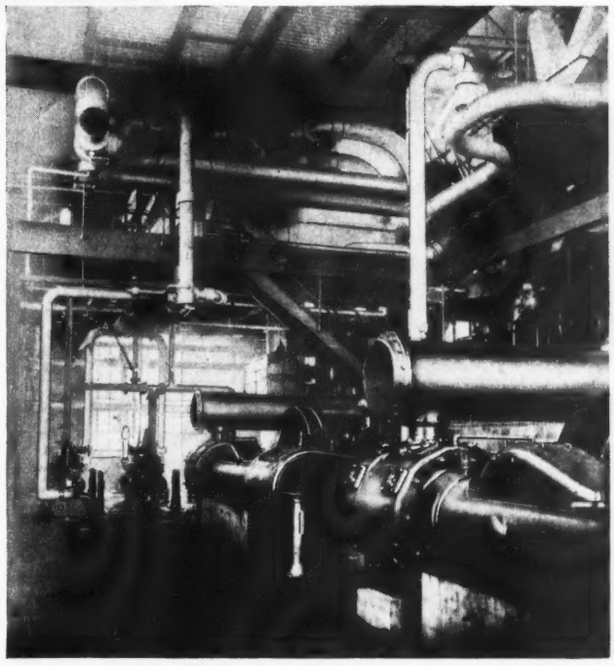
Four branch pipes deliver exhaust to a riser which leads to the feed water heater and the back-pressure valve. Each of these branches is provided with an opening to atmosphere, which makes it possible to operate essential pieces of equipment and exhaust to the atmosphere during such time as work is being done on either the back-pressure valve, feed-water heater, or other valves in the exhaust lines.

The water supply enters at one corner of the building, with a main branch to the feed-water pumps, heater and cooling circulation of the compressors and fan units. A second branch delivers water to the storage tank of the locomotive boiler-washing and filling system. The feed pump supply may be taken from the heater or from the city main, as occasion requires.

Feed water, free from air, at a temperature of 220 deg., is delivered to the boiler by either of two turbine-driven centrifugal pumps at a pressure of 260 lb. Either of these pumps has sufficient capacity to supply two boilers operating at full load. Feed-water regulators are provided for controlling the level in the boilers.

The two air compressors, cross-compound on both steam and air ends, are each rated to deliver 1,920 c.f.m. of air when operated at 165 r.p.m. Automatic governors working through riding cutoff type of valve motion adjust the compressed air delivery to requirements. Sectional air filters, with the intercoolers at the machines, and an aftercooler in the main delivery line, provide the clean dry air desirable in railroad work.

Instrument equipment is extensive and includes those units which go to make possible close control of plant operation. A steel panel near the front of each boiler contains boiler meter, multiple draft gage, CO_2 indicator and steam pressure gage. The operating lever of the flue damper is just below this panel, which makes for easy adjustment of air to steam flow. The meter panel in the office contains an electric clock, a row of recording



All covered pipe lines are painted with aluminum and each is stenciled as to content and direction of flow

and integrating flow meters, a CO_2 recorder with pens for each furnace, a single instrument recording the temperature of the exhaust entering the feed-water heater, the temperature of the feed water entering and leaving the heater, the temperature of the steam in the headers and the temperature of the gas in the stack, and a recording pressure gage with pens for steam pressure, feed water and compressed air.

The equipment required for locomotive boiler washing and filling and the direct steaming of locomotives is made up of pumps, sludge tanks, condenser and deaërator, all of which is inside the power plant. Two large insulated steel storage tanks have been placed outside the building. Two reciprocating duplex pumps of a capacity of 400 g.p.m. provide water for washing and filling. A third, held in reserve, is so connected that it may be used for either washing or filling.

At each locomotive pit there is a downcomer with a universal joint for connection to the blowoff valve of the locomotive. Floor operated valves makes it possible to connect this downcomer to any one of three main overhead pipe lines that comprise a filling line through which water at 200 deg. continually circulates, a direct steaming line from which steam at boiler pressure is always available, and a blow-back line. A separate system with drop lines at each pit provides for the circulation of wash-out water at approximately 120 deg. F.

When a locomotive is coming into the engine house for wash-out, the fire is dumped at the ashpit and the locomotive moves across the turntable to the house under its own steam. After connection has been made, with the downcomer, water and steam in the boiler are blown back to the boiler plant. The boiler is then washed with water from a hose attached to the wash-out line. When the boiler is ready for filling, steam is first admitted for warming the boiler shell, and then clean filling water at 180 deg. is admitted. Shortly after the water begins to fill the boiler steam is again admitted, and the mixture of steam and hot water is continued until the proper water level is reached. A small amount of steam is then admitted continuously, maintaining the boiler at a pressure of about 100 lb. Shortly before leaving time a large steam valve is opened and the pressure is raised to about 150 lb., with which the locomotive leaves the house.

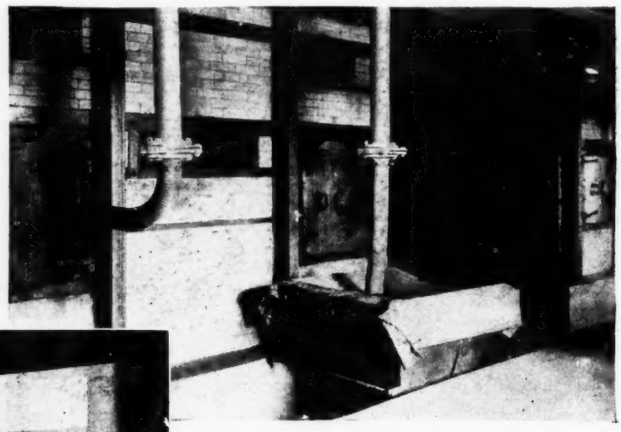
Locomotives that are to remain in the house for a considerable time, and which do not require wash-out, are floated at 100-lb. pressure during their stay, and the pressure is boosted just before leaving time.

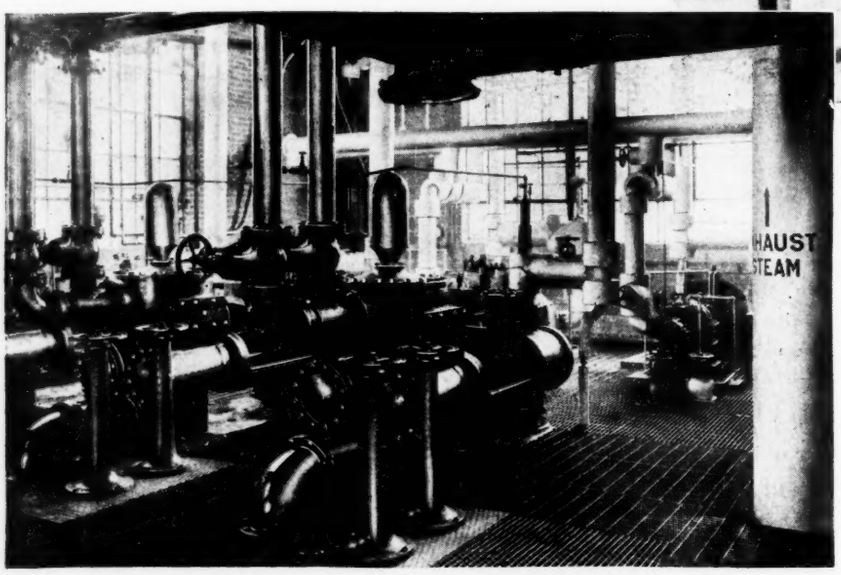
The blow-back line terminates in a sludge tank, which also acts as a separator for water and steam. A part of the water returning under pressure flashes into steam, and this with the steam from the locomotive boiler passes into a condenser, where it mixes with cold clean water. This water, the temperature of which is raised by the steam, passes into the filling tank. The water from the locomotive passes into a wash-out tank.

Deaëration of the filling water is effected by circulating the water from the filling tank through a small deaërating heater located on the mezzanine level. The air that separates out at the top of the heater is removed by a water-operated ejector. Steam for heating the water is obtained from the main exhaust line.

Operation during the past few months has been at loads varying from 20,000 to 70,000 lb. of steam per hour, with fluctuations that have ranged from 3,000 to 60,000 lb. during intervals of from 5 to 15 min. Maximums of 70,000 lb. steam per hour have been maintained with one boiler and one coal pulverizer operating at 300 per cent rating for short intervals. With a smoothing out of these peaks, continued operation with one boiler during the summer months will be possible.

During an interval of test operation with a load of 44,000 lb., or 197 per cent rating, an over-all boiler efficiency of approximately 80 per cent was obtained. During this interval the feed-water temperature was held at 220 deg., the average furnace temperature was 2,500 deg. and the CO_2 14.5 per cent. Coal of 14,270 B.t.u. was fired at the rate of 4,330 lb. per hour.





Rear view of combustion chamber, showing ash car on depressed track receiving ash from back pass of boiler

Boiler feed pumps and locomotive boiler-washing and filling pumps

...RIGHT OUT OF THE PLANT. .

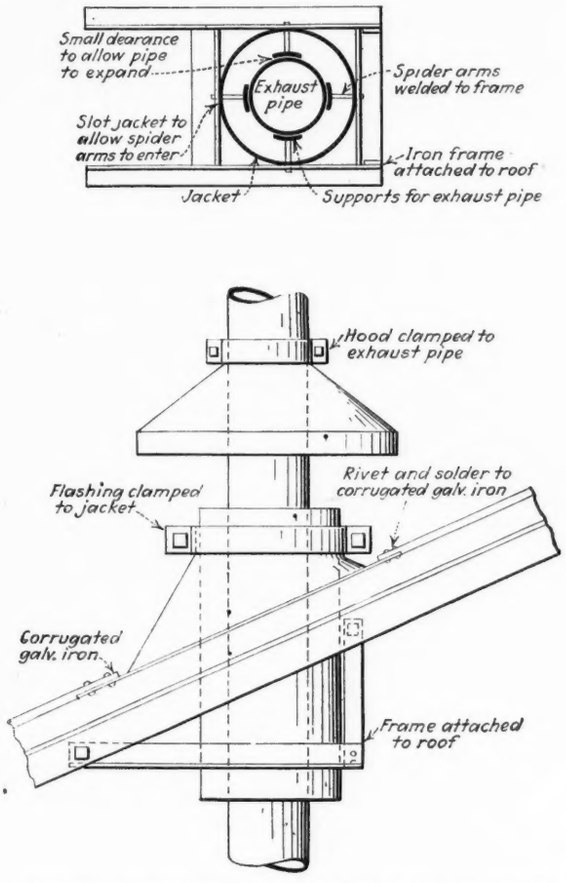
Device to Stop Vibration of Overhead Exhaust Muffler

IN PLANTS where a gas-engine, direct-driven compressor is used the muffler is often overhead, with the exhaust piping taking off from the top of the power cylinder and running up through the roof. To keep down the temperature of the room caused by these hot pipes a jacket is usually placed around the exhaust lines and a draft is induced whereby the hot gases are dissipated in the air. To stop the vibration of the exhaust pipe due to the pulsations of the engine it is necessary to brace it but at the same time to take care of the expansion. One method of doing this is illustrated.

A bracket is built from the truss of the building so that the outer pipe or jacket will rest snugly against it. This prevents vibration of the jacket but does not hold the pipe itself. A spider is built up from this bracket or frame to support the stays for the pipe. On the inner end of the arms of the spider small pieces of pipe or ¼-in. plate bent to a radius the same as the pipe and about 4x6 in. in size are welded. These are passed through slots cut in the outer casing or heat jacket and serve to prevent the exhaust pipes from vibrating, but at the same time permit of lateral expansion.

Where the roof is of corrugated galvanized iron there must of necessity be a flashing—water-tight but not rigid—to allow for expansion. A metal clip is made to fit lightly around the casing, and the flashing proper is then soldered to it. The other side of the flashing, where it goes under the corrugated iron, is held by small rivets before soldering. If it is soldered only, the vibrations tend to loosen the solder and water will creep in. The rivets act as a stiffener for the solder.

Long Beach, Calif. M. C. COCKSTOTT.


Small dearance to allow pipe to expand
Exhaust pipe
Spider arms welded to frame
Slot jacket to allow spider arms to enter
Iron frame attached to roof
Jacket
Supports for exhaust pipe
Hood clamped to exhaust pipe
Rivet and solder to corrugated galv. iron
Flashing clamped to jacket
Corrugated galv. iron
Frame attached to roof

How the exhaust pipe is stayed but left free to expand

How the Engineer Can Help

USUALLY we find in our technical publications only professional information, or, as at present, also remarks about the slow speed of the wheels of industry. Although it is not customary for engineers to take a stand in economics and politics, it would seem that we could render a valuable service toward recovery from the prevailing depression by trying to make others see the world as we do, that is, more from the viewpoint of serving mankind than of making money.

Our economic structure has been, and is, almost completely governed by the idea of profits, which proved to be a workable basis so long as the strict policy of "caution and waiting" was not so firmly established by our business leaders. This policy was the result of an unfounded fear, but now this fear has spread all over the nation and a general buyers' strike is the result.

It cannot be denied that much of the present depression is due to the principle of restrictions practiced by many of the large corporations right after the market crash.

All of us have seen how, since last fall, many ideas about improving existing manufacturing facilities have been choked, and when the reason was asked the answer was almost uniformly that the cash must be kept together in expectation of bad times. This was the cause of the depression—primarily mental. Therefore, in order to bring about a betterment of conditions the mental attitude must be changed.

Now there is every reason to believe that the engineer could help materially by spreading his thoughts through all possible means, newspapers, magazines, lectures, etc.

One man can do nothing, but if we all unite and try there is no doubt that the influence of such constructive action will be felt before long.

It has never been really profitable to practice the idea that a larger cash reserve than reasonably necessary is more to advantage than investing in better engineering. But now it seems that to abandon this idea is the first step toward recovery from present economic ills.

We engineers should use all our influence as a group and as individuals to see that all work that was believed necessary for more profitable operation in thousands of manufacturing plants, and which has been postponed since last fall, should be started without further delay. The spell of "cautious waiting" must be broken, and this process must begin at the head of the financial structure.

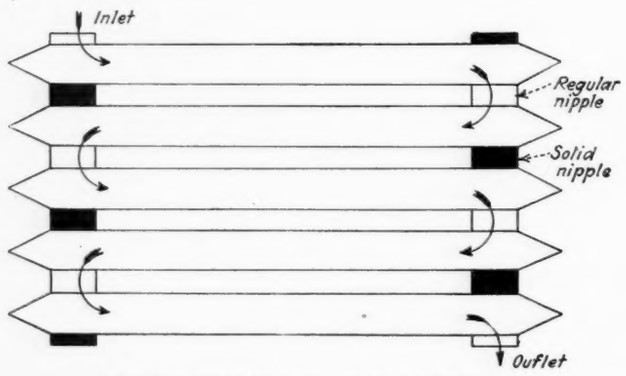
Increased action along the lines of application of better and more modern engineering would help to re-establish the confidence of the public and would give impulse to many lines not directly connected with it. Work of this kind is the only business activity that can be done at present on a large scale without creating clogged markets, which fact needs no explanation.

Criticism is all right, but it must be followed by constructive thought to have a real purpose. Let engineers unite along the ideas outlined and everyone will find ways to apply them to the benefit of the nation.

Milwaukee, Wis. K. A. OAKMAN.

Cooling Heating System Returns With Cast-Iron Radiator

RADIATION exposed to blasts of cold air usually is operated with steam pressures above those ordinarily used for heating purposes. When the cold air strikes the radiation at a high velocity there is a tendency for a vacuum to be formed due to the sudden condensing of the steam. This area of low pressure tends to hold a portion of the condensation in the radiator and makes complete drainage difficult without a vacuum return line, and when a vacuum return line is used the condensation is usually too hot for the pump to handle, thereby destroying the differential in pressure required for efficient operation.



Cast-iron radiator arranged as a cooling coil

Cooling coil radiation is often used to remedy the condition and is usually installed at the foot of a return riser or across the return main. It provides additional space heating and at the same time decreases the temperature of the return to that corresponding to vacuum necessary, usually about 15 inches.

To reduce the temperature of the returns with a minimum of cooling surface all parts of the surface should be exposed to condensate and be active at all times. Ordinarily, cast-iron radiation is unsuited for this work, as it is possible that much of the surface will be bypassed, the condensation passing from the inlet to outlet along the shortest path.

The accompanying sketch shows how an efficient cooling coil radiator may be built from tubular cast-iron radiation and installed on a wall or column of a building to receive the condensation of an overhead unit heater. The dark space between sections denotes a solid right and left hexagon nipple, and the white space at the other end of section denotes a regular right and left hexagon nipple. The arrows show the flow of condensate from section to section. WILLIAM ANDERSON.

Brooklyn, N. Y.

Laying Up a Steam Turbine

SOME months ago a question was asked in *Power* as to the best way of laying up a turbine, and a number of answers were given.

I should like to suggest that the turbine should merely be shut down, and that if the stop valve cannot be relied upon to remain tight the steam pipe should be blanked off on the turbine side—not on the live steam side—to prevent ventilation. The air pump will take away any remaining moisture, and with the machine sealed up it should be immune from any corrosive action. The introduction of oil, as suggested by one contributor, is asking for trouble. D. H. PHILLIPS.

London, England.

Personal Equation May Determine Engineer's Progress

READING an article written by a prominent engineer connected with a public utility company, I found, among other things, the remarks I am quoting. These observations, coming from where they do, seem to me to be significant.

The author said, in part, "Few men in any walk of life —excepting only an occasional outstanding genius—win unusual success on knowledge, ability or talent alone. These are necessary, of course—but the personal equation is, in the last analysis, the factor which will determine his progress. The man who is to get ahead is the one who can mix well with other people. Whether a contract or a piece of business is awarded to one firm or another is most generally determined by the personal relationships among the men involved."

The author of this article pointed out that the man who is likely to succeed is the one, who—to use his own words —can mix well and wear well with other people, the one who is versatile in his interests. My ideas are somewhat different from what this writer had in mind. My experience had been that the man who is going to get ahead, in engineering at least, is the man who knows somebody, who has somebody to help him along, or pull him along if you wish. I have come to the conclusion that the man

who pays the engineer is not so much interested in what you know, or how much you know. It is whom you know who counts.

I had the good fortune to get a good position a few years ago because I was introduced by an engineer whose reputation is of the highest. The prospective employer did not even ask what I had been doing. He did ask where I was working at the time, but he never did learn what I was doing before I joined his company.

On another occasion I had the misfortune to work under a man who held his position because of his close friendship with his superior. It was common knowledge that this man did not know as much as many of the men under him. One of his favorite themes was how much good experience I was getting by working for him—it was one of my first places after I came from the university. It took me about two years to unlearn some of the novelties I picked up from him. Although this man's ability did not qualify him for a better position than that of head office boy, he had attained the rank of executive in a rather large company manufacturing important power plant equipment.

It seems rather unfortunate that conditions are like this. Every man cannot be a genius; very few engineers seem to have the ability to mix well; not every engineer can acquire influential friends.

What is an engineer to do after working hard to make something out of himself and then finds that he is up against conditions like these? Sometimes it seems more profitable to form influential friendships rather than learn mechanical principles and other subjects usually taught to the beginner. ALBERT E. PITCHER.

Philadelphia, Pa.

Refitting Turbine Packing Blocks

WHERE carbon segments are used as packing in the sealing gland of a steam turbine, they must be fitted perfectly to the turbine shaft if best results are to be secured. If the fitting has been properly done the rings will soon take on a high polish, which is conducive to small friction and wear. After a turbine has been operating for some time these segments may be grooved or scored by dirt getting into the gland.

When a turbine is overhauled and the carbon blocks are found to be grooved or scored they should be dressed down smooth again. One of the best ways to dress them up is to obtain a mandrel of wood or steel the same diameter as the turbine shaft. A piece of emery paper is then stretched over the surface and held in place by bands or other means. Each block should be dressed on this paper until all scores or grooves are removed. The emery paper should then be removed, a paste of fine emery and oil made up, this applied to the form and each block again bedded. This will improve the surface and remove any scratches left by the emery paper. When this is finished the paste should be wiped off and each segment buffed. This will serve the dual purpose of giving a final finish and removing any emery grit that remains.

When repacking, all dirt or grit should be wiped from the gland and care taken to see that the segments butt properly at the joints. The garter spring, which holds the packing to the shaft, should also be tested, and if found to be weak or corroded it should be replaced.

Garden City, Herts, England. W. E. WARNER.

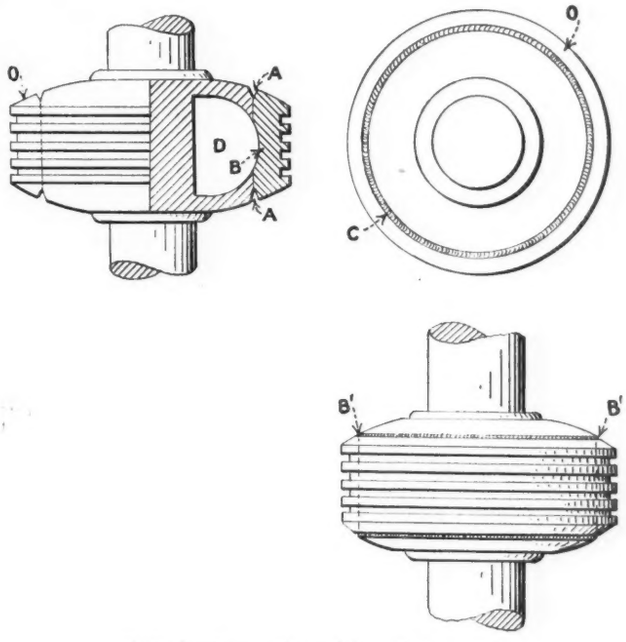
Repairing Gas Engine Pistons by Electric Welding

FIVE pistons for 29-in. stroke, horizontal twin-tandem double-acting gas engines were recently repaired by arc welding in a Texas machine shop. The ring grooves had been re-turned previously and wider rings used to compensate for wear. The periphery of the pistons had also worn down to such an extent that blow-by could not be prevented, causing stuck rings, with the result that the piston rings and grooves were badly burned.

Since this type of piston is expensive, it was suggested that some method be worked out whereby the old pistons could be rebuilt. As shown in the illustration, the pistons were turned down to the water cavity *D* and a steel casting *B* made to take the place of the metal removed in the lathe. This ring has the same width and diameter as the original piston face and is about 5 in. thick.

In addition to a careful shrink fit, the casting and original body of the piston were arc-welded together, V-grooves being cut at the junctions *AA*.

Vertical welding was employed to assure thorough penetration and a careful weld. The cost was less than



Method of renewing piston ring grooves

10 per cent of new pistons and the work required only a few days after the steel casting rings were obtained.

The piston rods had worn oval, the wear taking place on the lower side, as is usual, which also allowed the piston to drag on the liner and permitted blow-by at the top. The first repair to the rods had been carried out by turning down the rod to a smaller diameter and building up the stuffing box to fit. Since this could not go on indefinitely in a series of repairs over a period of years, another method had to be worked out. This consisted of building up the worn shaft by depositing new metal with the arc. The shaft, of course, had to be turned down in a lathe and tested for round and straightness after the welding was completed. ORVILLE ADAMS.

Dallas, Texas.

From Among Readers' Problems

Conducted by
L. H. MORRISON

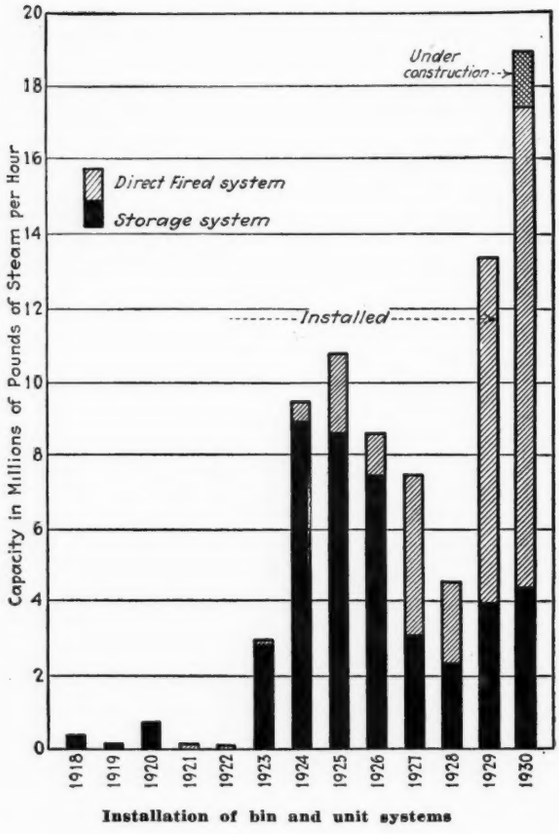
SIZE OF EXCITER—*How is the size of an exciter determined for an alternating-current generator? For example, what size exciter would be required to supply current to the field coils of a 240-volt, 2-phase, 200-kw. alternator, running at 200 revolutions per minute?* W.N.J.

The exciter capacity required for an alternating-current generator will vary with the size and type of machine. Small, low-speed generators require up to 3 per cent of their capacity for excitation. Large, high-speed turbine-alternators may require as little as 0.5 per cent. A high-speed, 5,000-kw., alternating-current generator would require about 35 kw. capacity for field excitation, while a slow-speed machine of this size would require about 70 kw. A 7.5-kw. exciter would have sufficient capacity to take care of the 200-kw. alternating-current generator to which you refer. It would be advisable to write directly to the manufacturers of the generator and have them make the recommendation. Since they know the exact characteristics of the generator, it may be they will find that a machine of 5 kw. capacity will be satisfactory. If a source of direct current is available of the same voltage as the exciter required, connect it to the field coils of the alternator and measure the current flowing in these coils. For example, assume that this current is 50 amp. and the field voltage is 115, then the power taken by the field coils is $50 \times 115 = 5{,}750$ watts. In this case a 7.5-kw. exciter is required.

UNIT AND BIN SYSTEM OF PULVERIZED-COAL HANDLING — *Is the unit, or direct firing, system becoming in more general use than the bin system for handling pulverized coal?* M.C.M.

The comparative installation of the two systems are shown in the illustration. It will be seen that in 1930 bin systems capable of firing boilers of 4,500,000 lb. of steam per hour were installed, while the unit capacity was 12,500,000 lb. of steam.

The drift to the direct firing system was pronounced in 1927, and by 1929 this system had definitely assumed leadership. The total yearly installed capacity of storage systems has been stationary for the past two years.



Installation of bin and unit systems

USING A 110-VOLT LIGHT IN BOILER INSPECTION—*When inspecting our boilers on the interior I have been in the habit of using an extension cord from one of the light sockets and a 50-watt, 110-volt bulb with a wire guard. The other day a boiler inspector visited the plant and catching me in one of the drums, said that I was courting death by using such a light. Is it dangerous or was he merely overcautious?* P. M'K.

An extension cord is dangerous and unless you are heavily insured you had better substitute a flash light. If the cord becomes damaged by rubbing, it is possible that you may touch the exposed wire and get a short circuit, which may result fatally, as it has in several instances.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

THE NEGATIVE exciting circuit collector ring on a 5,600-hp., 514-r.p.m., 60-cycle synchronous motor in an electrolytic zinc plant, plates the copper from the carbon-copper composition brushes on the ring, causing serious sparking and heating and often entails a shutdown of the unit to regrind the ring. Carbon brushes do not do as well as the present type in use. Will some of POWER's *readers suggest a cure for the trouble?* E.C.C.

THIS is a rather common and annoying trouble, affecting collector rings of all sizes. The present collecting equipment must be kept in perfect condition to determine if a change in brushes is advisable. The interiors of the brush-holders must be kept clean, so that there is no binding; spring tension must be even, and great enough to insure good contact with the rings; brush shunt lugs must be tight, with the shunts in good condition; the rings must run true; the brush rigging must be free of vibration; and each brush must fit the collector ring perfectly. Little, if any, lubricant should be used.

In view of the low current density, 33 amp. per square inch, it would seem that the trouble should disappear after the foregoing details had been given careful attention. If the trouble persists brushes of higher conductivity should

be used, and any well-known brush manufacturer's aid should be enlisted in arriving at the selection made. Trial brushes could doubtless be obtained without charge.

If the trouble is not eliminated by an extended trial of brushes it would appear advisable to add two or three brush-holders to each ring, and use eight or nine brushes of the best grade.

If, with the additional brushes, trouble continues, matters can be helped by interchanging the leads to the collector rings at monthly intervals at times when the motor may be shut down. This change in polarity is sometimes made periodically on machines that are free of trouble, to maintain the rings in equally good condition.

A recent development that will undoubtedly give good results is to cut a helical groove on the surfaces of the collecting rings. Such a groove should be $\frac{3}{32}$ in. deep and have a $\frac{3}{8}$ in. pitch. Remarkable improvement in both collector-ring and commutator performance has been brought about by this simple expedient. Grooving should be given fair trial before adding additional brushes.

ROY WEST.

Irvington, Calif.

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THIS seems to be the same trouble we had a few years ago with our 300-kva., 900-r.p.m. turbine-generator. We tried to eliminate the trouble for a long period, and destroyed a ring by turning and grinding it. We were using National Carbon Company brushes, No. 255. After a new ring was put on, and the trouble continued, a change was made to a National Carbon Company 634 brush. This is a soft-graphite, lightweight brush. They were installed after the ring had been made true by grinding at full speed.

The brushes have been in use over a year and the rings still have a good polish. The brushes have been in daily use and have shown but little wear.

A. J. STEVENSON,
Power Engineer,
Westinghouse Electric & Mfg. Co.
Mansfield, Ohio.

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TROUBLE similar to that complained of by E.C.C. has been experienced on one of our 10,000-kw., 1,800-r.p.m. generators. In an effort to eliminate sparking and spotting of the collector rings, as an experiment on a third section of the negative ring, brushes with a comparatively high copper content were tried. The results of this trial were entirely unsatisfactory, due to a film of copper being deposited on the ring which developed a tendency to flake off, causing serious sparking. Fortunately, this trial was made on only one-third of the collector ring. On the remaining two-thirds soft carbon brushes had been installed, and they satisfactorily carried the current until a shutdown could be made to resurface the ring and change the brushes.

Sparking and pitting of the slip rings on this generator has been stopped by using a softer grade of carbon brush and reducing the current density per brush by installing additional brushes. The trouble mentioned in the question is undoubtedly caused by electrolyte action, and it can be remedied by removing the high-copper-content brush. It is also recommended that the use of sandpaper in cleaning the copper film from the rings be discontinued and that the rings be ground and polished by a carborundum wheel, emery cloth and, finally, crocus. If the copper-content brushes are still used the polarity should be reversed from time to time, at the first sight of copperplating.

C. L. COOK.

Holtwood, Pa.

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A Question for Our Readers

WHAT is the best method of joining the ends of a heavy double leather or 8-ply or 10-ply rubber belt, assuming that cementing is out of the question?

L.R.B.

Suitable answers from readers will be paid for[1] and published in the April 21, number

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IN THE operation of rotating machinery employing collector rings to conduct alternating current to the rotating element, little trouble is experienced from copperplating when using semi-metallic brushes. In the present instance, if more satisfactory brushes cannot be obtained, I should suggest that the polarity of the exciting circuit be reversed periodically.

As the polarity of the exciter is not easily reversed without an auxiliary direct-current supply, a double-pole double-throw switch may be installed in the synchronous-motor field circuit. The field polarity can be reversed while the motor is operating, provided a light load is being carried. The field circuit is first opened by the main field switch, and then the double-pole double-throw switch is thrown to its opposite position. The required frequency of reversals is determined by inspection

Wilmington, Del. C. S. COLLIER.

[1]As an alternative to cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired.)

Morrison's *American Diesel Engines;* Walker and Crocker's *Piping Handbook;* Norris and Therkelsen's *Heat Power;* Emswiler's *Thermodynamics;* Church's *Steam Turbines;* Uehling's *Heat Loss Analysis;* Croft's *Steam Power Plant Auxiliaries and Accessories;* Powell's *Boiler Feed Water Purification;* Osborne's *Power Plant Lubrication;* Moyer and Fritz' *Refrigeration;* Rietschel - Brabee's *Heating and Ventilation;* Annett's *Electric Elevators.*

I SUGGEST the polarities of the rings be reversed periodically by installing, if necessary, a switch for that purpose. This will divide the wear and will give the negative ring a chance to polish and brighten up. The negative ring is positive to its brushes, and when sparking becomes severe minute sections of its surface actually melt and absorb copper from the brushes, a very rough surface resulting.

After carefully grinding the ring and fitting the brushes, sparking, although indescernible, still continues. I have proved that on our machines by means of a portable radio trouble-finder. The noise from the positive brushes is hardly noticeable; from the negative it is simply terrific, the cause being so-called pin sparks under the brushes.

I should also suggest that some plain carbon brushes and some of the original brushes be used. If necessary the carbon brushes can be heavily copperplated.

One can always tell which ring is positive and which is negative from its appearances after having run awhile, the negative being dark and smutty, the positive smooth, bright and glassy.

HENRY MULFORD,
Chief Electrican,
Patchogue Electric Light Co.
Patchogue, N. Y.

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I BELIEVE the plating of the collector ring is entirely due to the acid in the moisture of the air, which is carried in suspension and collects in minute quantities on the ring and brushes.

To remove the acid it is suggested that washed air be supplied to an insulated box built around the rings with a small clearance for the shaft on the bearing side and enough clearance for the shaft and leads on the other side. The box could be coated on the inside with an asphaltum paint.

Air can be supplied to the box by a small blower connected between it and a small spray-type air washer, and the clearance openings around the shaft would be enough to allow the air to escape. The air, in washing, would have most of the acid removed, so that practically clean air would be in contact with the collector rings.

A small blower of about $\frac{1}{3}$ hp. capacity would be large enough to supply the necessary air to keep a small positive pressure on the inside of the collector housing.

B. A. HOLLENBECK.

Montclair, N. J.

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A PAPER, "The Application of the Helical Groove to Slip Rings and Commutators," by G. M. Little, presented at the winter convention of the A.I.E.E., in New York City, Jan. 26 to 30, 1931, has much in it of interest to E.C.C. or anyone having trouble with brushes or commutators and slip rings. An abstract of this paper will appear in an early number. Copies of the complete paper can be obtained by writing to the American Institute of Electrical Engineers, 29 West 39th St., New York City.—EDITOR.

Higher Temperatures and Better Economy Mark European Power-Plant Practice

BY A. C. BLACKALL

London, England

AMONG the interesting developments in power plant practice in Great Britain and Europe during the last decade are the steady growth in the use of higher pressures and temperatures, the advance in thermal efficiency, and the increasing differences of opinion as to the relative advantages of mechanical stoking and pulverized-fuel firing.

The tendency toward higher steam pressures is almost universal, and standard practice is now between 500 to 750 lb., while the number of boilers for 1,200 to 1,800-lb. operation has increased appreciably. Progress in this field is rapid in Germany, France and Belgium, although European countries in general have not yet achieved American pressures. Forged-drum boilers of the kind required for these high pressures are increasing to a disturbing extent the capital cost of power stations.

Excellent progress has been made throughout Europe with the use of high superheated steam temperatures, especially within the range of 750 to 900 deg. F. Some typical British and Continental high-temperature installations now in course of erection or recently completed are: West Ham, 780 deg. F.; Dunston B, 825 deg. F.; Sheffield, 800 deg. F.; Hull, 775 deg. F.; Hackney, 800 deg. F.; Ironbridge, 800 deg. F.; Battersea, 850 deg. F.; Clarence Dock, 825 deg. F.; Synthetic Ammonia & Nitrates, Ltd., Billingham, 856 deg. F.; St. Denis, Paris, 850 deg. F.; Vitry Sud, Paris, 800 deg. F.; Schelle, Belgium, 796 deg. F.; Langerbrugge, Belgium, 840 deg. F.; Monceau, Belgium, 897 deg. F.; Quaregnon, Belgium, 887 deg. F.; and Rotterdam, 800 deg. F. The radiant-heat superheater has made strides forward in popularity, and interest in the separately fired superheater has increased considerably.

The decade which terminated with 1930 witnessed a substantial advance in the thermal efficiency of British electric power stations. In 1921 the highest over-all thermal efficiency recorded by any public supply station in Britain was 17¾ per cent, but for the six months ended March 31, 1930, the new Kearsley power station of the Lancashire Electric Power Company attained 24.36 per cent, although its output was only 64,000,000 kw.-hr., with a load factor of 55 per cent. In the same decade the lowest consumption of coal per kilowatt-hour generated has fallen from 1.7 lb. to 1.18 lb. As recently as 1918 the average coal consumption of all generating stations in the United Kingdom was 3.47 lb. per kilowatt-hour generated, and the average over-all thermal efficiency was not more than 8½ per cent. As the average coal consumption in 1929-30 fell to 1.97 lb., it is probable that an average figure of 1¾ lb. will be attained within a comparatively short time.

In general the turbine efficiency of British power stations has increased, although the actual number running better than 20 per cent is still comparatively small.

Steel-tube water-cooled combustion chamber walls are being used more extensively, and in some cases 60 to 65 per cent of the total heat used for steam generation is being absorbed.

In the field of boiler firing, although no very clear indication exists in broad general principle as to whether pulverized-fuel firing is superior to mechanical stoking, except for boilers with an evaporation exceeding about 400,000 lb. per hour, the unit pulverizer would appear to have advanced at the expense of the "bin and feeder" system. To judge from recent station design, opinions are fairly equally divided in Britain regarding the use of mechanical stokers, bin and feeder pulverizers, and unit pulverizers. Apparently, also, the time is approaching when it will be possible to operate with success the cylindrical boiler internally fired with pulverized fuel. Other features of the latter principle are greatly increased use of the turbulent type of short-flame burner, reduced size of combustion chambers, and the passing of heated air through the pulverizers. Mechanical stokers, of both the multiple-retort and the traveling-grate types, have been improved and are now able to operate still larger boilers.

Air heating continues to be standard practice for British power stations, with both pulverized fuel and mechanical stokers, and is coming a little more into use for industrial work. The feedwater economizer now finds rather less use with water-tube boilers, but considerable progress has been made with the gilled-tube type of economizer with soot blowers, at the expense of the ordinary smooth-flow circulation tube unit. Cast-iron economizers, however, can now be operated up to 300 lb. pressure, because of the use of higher grade iron and positive joints, while the virtually universal use of the centrifugal feed pump for large plants has reduced the internal strains.

Fuel technologists are devoting greater attention to the utilization of low-grade fuels for steam generation. This tendency is observable both in power station and industrial practice, and there is a growing feeling, as shown by various contributions that have appeared in the technical press, that much more use ought to be made of coals with high ash content and similar products at collieries and iron and steel works with private power stations supplying Britain's electrical grid. Improved designs in forced-draft hand-fired furnaces, traveling-grate stokers, and unit pulverizers alike have rendered these fuels easier to consume at relatively high efficiency.

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Welding Machines Made More Stable

AT THE recent A.I.E.E. meeting in New York City (Jan. 26-30) a session was devoted to arc welding. Several interesting developments in welding machines were made public.

The following summary was omitted, for lack of space, from the general report published in the Feb. 3 number of *Power*.

A new system for direct-current arc welding was described by S. R. Bergman, consulting engineer, General Electric Company, West Lynn, Mass. The most interesting feature of this development is an external inductive device, called a transforming reactor, designed to reduce load transients, which tend to produce inferior welds.

The inductive device contained two windings, a primary winding connected in series with the arc, and a secondary winding connected in series with the shunt field of the cross-magnetic circuit. These two windings are connected in such a way that the direct current flowing through them will magnetize in the same direction.

Combined with a specially wound generator, the transforming reactor serves the dual purpose of eliminating transients in the generator and supplying reactance in the welding circuit. Experiments have shown, said Mr. Bergman, that this combination, for both hand and automatic welding, lays down the metal with ease and accuracy under all conditions met in welding and produces welds of uniform strength.

Very similar was the welding remedy proposed by J. H. Blankenbuehler of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The two primary difficulties referred to by Mr. Blankenbuehler are the sticking of the electrode to the parent metal and the extinguishing of the welding arc by a slight disturbance.

The remedy suggested, somewhat similar to that mentioned in the previous paper, is the use of a transformer, with the primary in the welding circuit and the secondary in the field circuit, proportioned to neutralize the momentary changes in the circuit.

With this device, said Mr. Blankenbuehler, all tendency to freeze, or to fail without apparent reason, will be removed. Moreover, the deposited metal is surprisingly free from porosity, due to the elimination of current surges. Thus, he said, a novice can readily strike and maintain an arc on his first trial, and produce much more satisfactory welds.

Another method of controlling transients in welding machines was described by F. Creedy of Lehigh University in a somewhat mathematical paper. The equipment described by Mr. Creedy makes use of a special shunt circuit.

"Resistance Welding of Motor Frames," a paper by Malcolm Thomson, engineer, Fabrication Department, General Electric Co., Lynn, Mass., described the method used by his company in the fabrication of motor frames by resistance welding. By the use of electric welding it has been possible, said Mr. Thomson, to produce frames 25 to 50 per cent cheaper than corresponding steel castings, and with much greater uniformity in dimensions and structure.

Electric Resistance Brazing

The general use of electric resistance brazing may become more general with the application of methods described in a paper by Samuel Martin, Jr., of the Industrial Engineering Department of the General Electric Company. Mr. Martin showed how lead-tin solder joints may be cheaply and efficiently replaced by electrically brazed joints. In application, he stressed those in which cables are brazed to connectors.

The process is simple, utilizing the high resistance of carbon blocks to the flow of electricity. The pieces to be joined are clamped between a pair of blocks, and current is passed through them and the joint. The carbon electrodes heat up quickly, and the heat passes from them into the parts being joined, raising their temperature to the welding point of the brazing alloy. The alloy, in the form of a thin strip for convenience, is then applied to the contact surfaces of the parts being brazed. It melts and flows through the joints, uniting the parts into a solid mass.

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Copies of "Wire Rope Problems Confronting Elevator Designers," a paper by James F. Howe, wire rope engineer, American Steel & Wire Company, Worcester, Mass., are available and may be obtained by writing to the American Steel & Wire Company, 208 S. La Salle St., Chicago, Ill. The paper covers such subjects as rope flexibility and ratio of rope to drum diameter; loads and safety factors; unit pressure in "U" and "V" grooves and effect of wear; drum hardness vs. rope hardness; value of highest-strength ropes for elevator work; means of increasing traction, equalization of ropes; effect of lubrication on traction; causes of drum wear; rope slippage or creeping; and accelerations limitations.

Midget Ruler of the Universe

THE TINY electron as the "missing link" which binds together all the sciences—chemistry, physics, electricity, radio, biology and astronomy—was discussed by O. H. Caldwell, editor of *Electronics*, New York, and former Federal Radio Commissioner, in an address before the Midwest Power Engineering Conference at Chicago, Ill., last month, under the title "The Electron—Midget Ruler of the Universe." Ways in which the electron has been harnessed to serve mankind in industry, communication, power transmission, music, therapeutics, surgery, were explained during the general banquet session of the conference.

Among other novel electronic applications described during the course of Mr. Caldwell's illustrated talk were the recent discovery of the Canyon Diabolo meteor in Arizona, by electronic methods; the "talking lighthouse"; electronic wills; direct-current power transmission; relays that operate in a millionth of a second; the bloodless "radio knife"; new electronic musical instruments; the super-accurate electronic clock; the electric eye used in safety work; photo-cell "smoke inspector"; vacuum tubes from 200-kw. to 10^{-17} watts; magic door-opener; the "lie detector" used by police departments; and high-frequency chambers for gently heating tired brains to stimulate faster thinking in modern business offices.

At another session of the same conference some possible future applications of electronics in the power field were revealed. It was shown that electron tubes have great possibilities as rectifiers for converting alternating current into direct, and vice versa. This new aid promises ultimately to solve the problem of high-voltage direct-current transmission.

Cost of Air Conditioning And Cooling[1]

IN AIR CONDITIONING and cooling in summer the engineering requirements are much more exacting than for heating in winter. In heating buildings there are only two principal items to be considered: First, heat transmission between the inside and outside temperature and to some extent wind velocities; second, infiltration due to window leakage, etc., which is affected both by temperature difference and wind velocity.

In summer cooling and air conditioning, however, in addition to allowing for the two factors already mentioned as required in heating, allowance must be made for sunlight on walls, windows and roof. The sunlight effect alone may make a variation of two to one in refrigeration requirements between a southern or western exposure and a northern exposure. In office buildings, especially, the effect of sunlight may add as much as one-third to the total requirements. This can be seen when it is considered that the heating effect of sunlight may be more than 4 B.t.u. per square foot per minute in temperate latitudes. All artificial lighting and other heating sources, such as motor-driven machinery, require one ton of refrigerating effect for every 3.8 kw. input. At the rate at which sensible heat is given off by the human body, 1/30 ton per person is required. Ventilation, whether supplied through leakage or artificially, requires all the air thus introduced be dehumidified and cooled from outdoor conditions to room conditions.

In general, more refrigeration is required to dehumidify the air than to cool it. The total requirements of refrigeration for ventilation are nearly as great in severe weather as the requirements for removing bodily heat.

Where individual rooms are cooled rather than an entire building, refrigeration requirements are more than double, owing to the fact that heat from the adjacent rooms passing through the inside walls, floor and ceiling must be taken care of as well as warm air leakage from these rooms. This factor makes for difficulties in cooling a single room or an isolated group of rooms in a large building.

Table I gives the summer and winter loads for ventilation and air conditioning in typical installations for which data are available.

An air-conditioning system is a year-round service. A complete air system provides for heating and ventilation, as well as for summer cooling and dehumidification. Heating is always a necessary cost, while the cost of ventilation, that is, fans and duct work, should be considered as a requirement independent of refrigeration and air conditioning. A whole modern ventilation system in an office building costs about as much as a heating system, while the necessary refrigeration for complete air conditioning, in addition to ventilation and heating, will increase these installation costs by about 50 per cent. In other words, in a complete air-conditioning plant we may charge about one-third to heating, one-third to ventilation and one-third to refrigeration. But on the other hand, in the completely air-conditioned plant ideal all-year-round service with perfect comfort conditions are obtained, contrasted with rather poor conditions in winter where heating only is provided. Air conditioning and ventilation not only provide summer comfort, but also winter comfort.

In estimating the cost for complete air conditioning for various types of buildings there must be taken into account the interest and depreciation based on the first cost of the plant, the cost of maintenance and repairs, the cost of power, the cost of fuel or steam, and the cost of the condensing water for the refrigerating machine. All of these items have been taken into account and proper allowance made, not only upon calculations, but also upon experience in actual installations. Table II gives the cost of complete systems of heating, ventilating and air conditioning for summer and winter. These costs give not only the unit cost for the installation, but also the actual cost of depreciation, interest and operation. The power cost is given as a separate item.

It will be noticed that both initial and annual costs are based on heating, ventilating and conditioning. In most cases, heating and ventilating are normal expenses which must be paid anyway. The actual extra cost of adding air conditioning, which also provides for heating and ventilating, is, on the average, one-third of the figures used in the table.

TABLE I—SUMMER AND WINTER LOADS FOR VENTILATION AND AIR CONDITIONING IN TYPICAL INSTALLATIONS

	Connected Load Hp. Summer	Connected Load Hp. Winter	Sq.Ft. Floor Area	Connected Load per Sq.Ft. Summer	Connected Load per Sq.Ft. Winter
Department Stores					
Bonwit Teller, New York	125	25	12,600	0.01	0.00198
Hudson Stores, Detroit	780	140	79,830	0.00976	0.00175
Hudson Stores, Detroit	1,525	395	233,990	0.00654	0.0017
L. S. Ayres Co., Indianapolis	404	114	78,250	0.00515	0.00146
Filene's, Boston	620	120	79,830	0.0078	0.0015
Kern's, Detroit	281	81	46,300	0.00606	0.00175
Macy's, New York	*Turbine Drive		136,700	.....	.....
Smith-Kasson, Cincinnati	69.5	18.0	9,250	0.0075	0.00195
Halliburton - Abbott, Tulsa, Okla	312.5	92.5	113,900	0.00275	0.000815
Sanger Bros, Fort Worth	375	95	82,700	0.00454	0.00115
Strawbridge & Clothier, Philadelphia	1,245	325	179,635	0.00695	0.00181
Titche-Goettinger, Dallas	345	65	75,900	0.00455	0.00086
Bon Marche, Seattle	*Turbine drive		145,800	.....	.....
Office Building					
Milam, San Antonio	650	200	200,000	0.00325	0.0010
Theaters			Seats	Approx. Power per 1,000 Seats, Hp.	
Roxy, New York	880	195	7,400†	119	26.5
Paramount, New York	580	180	3,500†	165	51.0

*In these installations exhaust steam from other steam driven engines is used to drive the turbine of the centrifugal refrigeration machine.
†Including standees.

TABLE II—TYPICAL COSTS FOR COMPLETE SYSTEMS OF HEATING, VENTILATING AND AIR CONDITIONING

Type of Building	Initial Cost per Sq.Ft.	Annual Over-All Cost per Sq.Ft.	Unit Costs (Based on Annual Over-All Costs)	Annual Power Costs (Rate in Parenthesis)
Dept. store; 160,000 sq.ft.; 6,250 people	$1.80	$0.32	32c. per yr. per sq.ft. of sales area	$15,923 (3c. per kw.-hr.)
Office bldg.; 325,000 sq.ft.; 2,450 people	1.25	0.19	1c. per man-hour	$13,896 (1.2c. per kw.-hr.)
Plant office bldg; 42,560 sq.ft.; 300 people	2.00	0.31	3c. per man-hour	$2,694 (3c. per kw.-hr.)
Restaurant and cafeteria; 12,644 sq.ft.; 760 people	3.60*	1.16*	1c. per meal	$4,748* (3c. per kw.-hr.)
Hotel (guest rooms); 120,000 sq.ft.; 600 people	1.50	0.50†	20c. per room per day	$13,600 (3c. per kw.-hr.)

*Higher initial and operating costs are due to a larger required capacity to provide for unusual heat load, more frequent air change, and larger number of people.
†Higher operating cost due to longer period of daily operation.

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VAPORIZATION BEFORE IGNITION—Neumann has recently investigated the vaporization process mathematically and found that, due to lack of time, no appreciable vaporization of fuel drops can occur before ignition. Only the time lag is available for the vaporization, that is, the time between the beginning of the injection and the beginning of the combustion. This interval is even shorter than assumed by Neumann, who calls it the interval between the beginning of the delivery stroke of the pump and the visible pressure increase in the indicator diagram. In reality, a considerable portion of this time is consumed by the "injection lag."—Dr. F. Sass in V.D.I. *Zeitschrift.*

[1]Excerpts from a paper by Willis H. Carrier on "The Field of Refrigeration in Air Conditioning and Methods of Its Application" read before the Fifth Midwest Power Engineering Conference, Chicago, Feb. 10, 1931.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

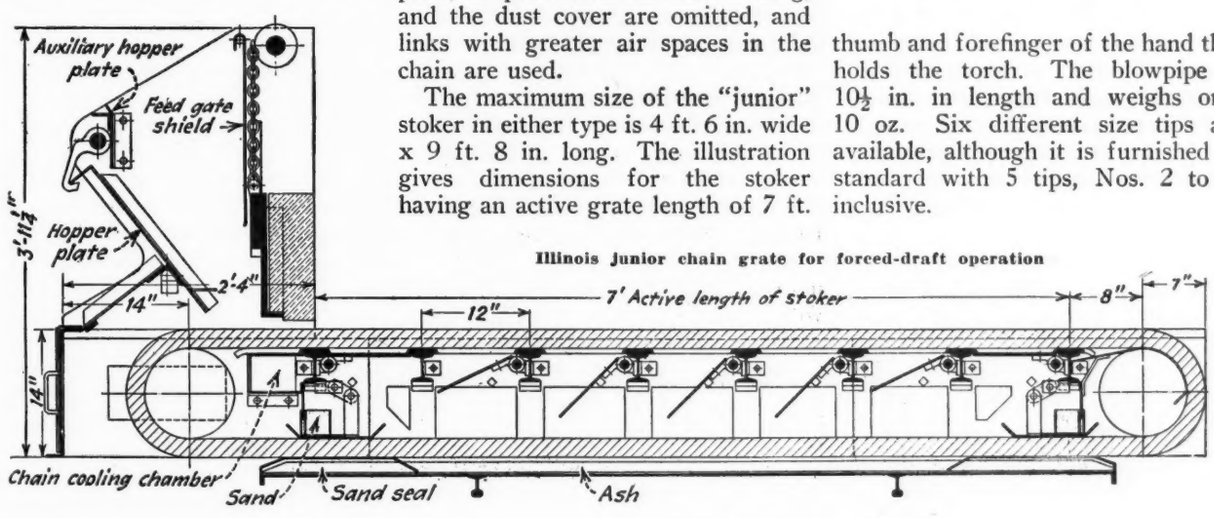
Junior Chain-Grate for Boilers up to 2,500 Sq. Ft.

TO MAKE the standard features of the Illinois chain-grate stoker available for smaller boilers ranging in size from 1,000 to 2,500 sq.ft. of surface, the Illinois Stoker Company, of Alton, Ill., has brought out a "junior" chain-grate unit. All of the features of the standard stoker have been duplicated in this unit of smaller size and less height. From top to bottom of chain strands the new stoker has a height of 14 in., so that it may be used readily under low-set boilers with little or no excavation.

The new stoker is made for operation under forced draft or natural draft. The accompanying illustration shows the arrangement of parts and the principal dimensions of the forced-draft type. The drive is the same as for the standard forced-draft stoker, consisting of a double worm-and-gear reduction embodying a shear-pin device and two-way thrust cap. Among other details of construction common to both large and small stokers are, worm-and-gear feed-gate lift, chain cooling chamber, dust cover, riding seal, return skids, heavily ribbed side frames and dampered air control. The natural-draft stoker is practically the same as the forced-draft type except that the front riding seals, the bottom seal plate, the provisions for chain cooling, and the dust cover are omitted, and links with greater air spaces in the chain are used.

The maximum size of the "junior" stoker in either type is 4 ft. 6 in. wide x 9 ft. 8 in. long. The illustration gives dimensions for the stoker having an active grate length of 7 ft. Installation may be made under 5-ft. settings. With higher settings the ash pit can be entirely above the floor, no excavation being necessary.

Either the forced-draft or the natural-draft "junior" stoker is operated by a 900-r.p.m. constant-speed motor belted to the stoker drive through a variable-speed pulley which allows a reduction in speed of from 50 to 75 per cent. There is a damper for each foot of grate length. These dampers are hinged at the side. as indicated, so that ashes and sifting do not collect on them. To give air-tight construction, the damper is closed against crimped steel plates. The stoker is designed to burn a wide range of coals, running from the best to inferior grades.

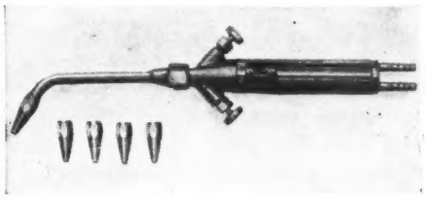


Illinois junior chain grate for forced-draft operation

Welding Blowpipe for Light Work

A RECENT addition to the line of welding blowpipes put out by the Linde Air Products Company, 205 East 42d St., New York City, is the type W107, illustrated. The new torch, which is suitable for light welding work of all kinds, operates on the medium-pressure principle.

The gases mix immediately in front of the handle, and the oxygen and acetylene valves are so located that they can be readily adjusted with the thumb and forefinger of the hand that holds the torch. The blowpipe is 10½ in. in length and weighs only 10 oz. Six different size tips are available, although it is furnished as standard with 5 tips, Nos. 2 to 6, inclusive.

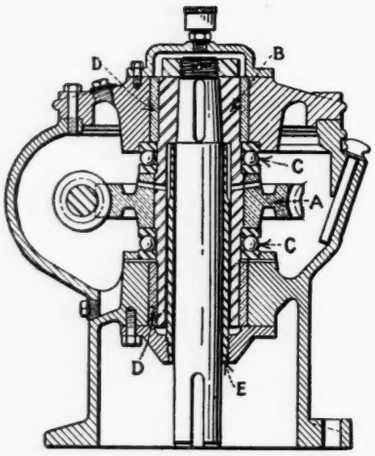


Type W107 welding blowpipe

Oil Leakproof Vertical Worm Speed Reducer

A RADICAL departure from established methods of controlling oil leakage, such as the use of packing glands, oil seals, etc., has been made in the new leakproof vertical worm speed reducer brought out by Foote Brothers Gear & Machine Company, 111 North Canal St., Chicago, Ill.

Referring to the illustration, the bronze worm gear ring *A* is pressed



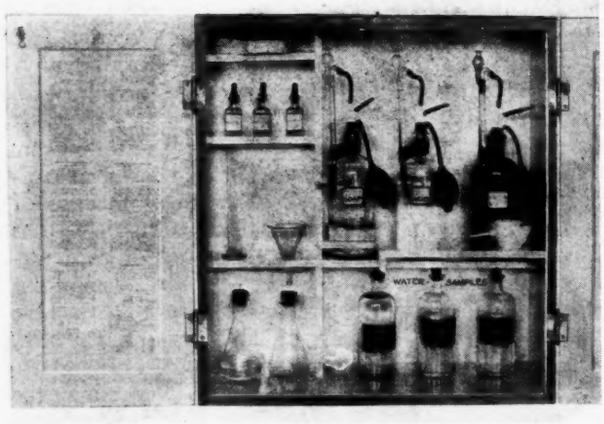
Cross-section of reducer showing details of construction

on a splined hollow steel center *B* and is held rigid on this center by two ball thrust bearings *C*. This complete arrangement is mounted on bronze bearings *D*, and the hollow center is securely fastened to the vertical shaft at the uppermost part of the reducer, thus forming a cavity below this point for nearly the entire length of the shaft. In this space a tube *E* is sealed and fastened to the lower part of the reducer, from where it extends upward to a point well above the oil level. At the top the opening of the tube is covered by the steel center *B*. This, it is claimed, prevents any oil from leaking out, and forms two chambers, one in which the worm gear operates and the other in which the vertical shaft rotates free from the contact of oil at all points.

Boiler Water Test Kit

IN THE accompanying illustration is shown a boiler water test kit made by the Henszey De-Concentrator Company, Watertown, Wis., for use, primarily, with the Henszey de-concentrator to allow the operator to check accurately the condition of his boiler water each day. By following the instructions attached to the cover of the case, it is claimed that anyone can make all of the necessary tests of raw water and boiler water in fifteen minutes.

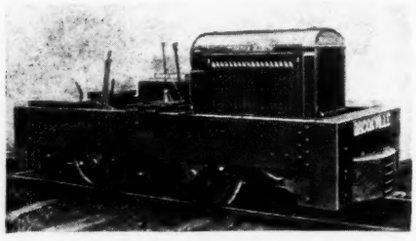
Inasmuch as the instrument is also suitable for test work in plants other than those equipped with continuous blowdown, it is now offered to the general trade. Report sheets are provided from which it is possible to forecast the possibility of priming, scale, corrosion, caustic embrittlement, etc.



Test kit for boiler water, with complete instruction sheet on inside of cover

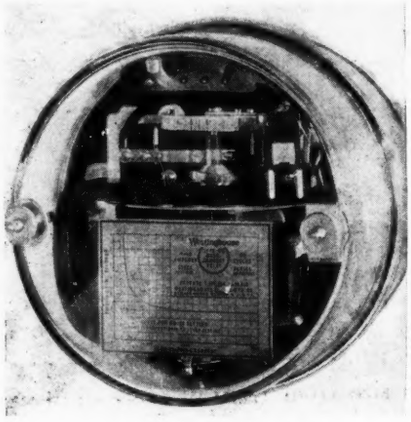
Industrial Locomotive with Five Speeds Forward and Reverse

TWO NEW MODELS, an 8-ton (BMD8) and a 10-ton (BMD-10), have recently been added to the line of industrial locomotives put out by the Brookville Locomotive Company, Brookville, Pa. Each unit is powered by a Model "300" McCormick-Deering industrial unit equipped with a five-speed transmission and clutch made by the same company. In addition to the standard transmission, each unit is equipped with an inclosed gear reverse that makes all five speeds available in either direction. Speeds from 2 to 16 miles an hour are available, and the transmission gears can be shifted while the load is in motion.



Type BMD-8 locomotive shown without cab

The new units are available in any gage from 22 to 56½ in. or wider and are equipped with either four pocket link-and-pin couplers or with MCB couplers for use with standard cars. Wheelbase, over-all height and other dimensions are variable within certain limits.



Type CO relay

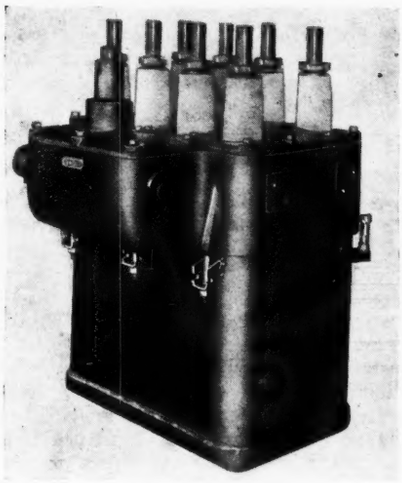
Improved Induction Type Relays

SEVERAL improvements in its induction type protective relays, Type CO and Type CR, are announced by the Westinghouse Electric & Manufacturing Company, Newark, N. J. They are made in standard models and also in special low-energy types for use where only a small quantity of energy is available for the operation of the relays.

Inspection of the relays has been facilitated by making the glass cover and the metal case both removable; the new contacts are more accessible and more conveniently adjusted; and, by means of new universal studs, mounting the relays on either slate or steel panels is simplified.

The 4 to 12 and the 4 to 16 ranges have been combined and superseded by styles having a range of 4 to 15 amp. The operation indicator has been improved in action and operation, and by means of a slight change in the wiring connections it can be set to operate on tripping currents of either 0.2 or 2 amperes.

All power-directional relays are available with directional control which prevents the overload element from starting until the directional element contacts are closed in the right position.



Breaker with inclosed-type mechanism

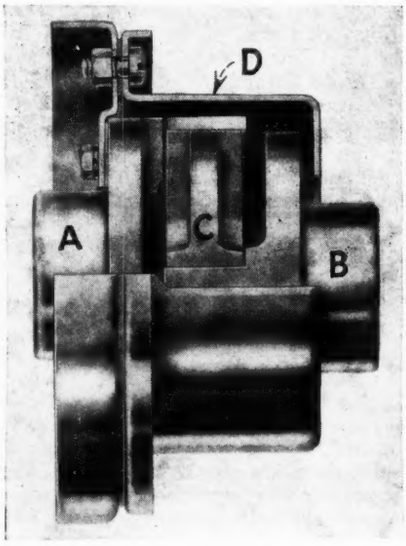
Indoor-Type Circuit Breaker

TYPE DR25 indoor oil circuit breaker with inclosed-type mechanism and all poles in one tank is announced by the Condit Electrical Manufacturing Corporation, Boston, Mass. This breaker offers the features of non-oil throwing, greater clearances, quick clearing operation, small space requirements and provision for venting gases.

It is furnished three- or four-pole, manually or electrically operated, for 600 to 1,200 amp. at 15,000 volts.

Inclosed and Lubricated Cross-Type Coupling

THE LINE of shaft couplings put out by Smith & Serrell, Globe Indemnity Building, Newark, N. J., has recently been extended by the addition of the Francke cross-type coupling illustrated. This coupling will take care of shaft misalignment up to $\frac{1}{16}$ in. and is suitable for drives where spring cushion for load shocks is not essential. It consists of four parts, hubs *A* and *B*, cross *C* and pressed-steel grease cover *D*. In the illustration the hubs *A* and *B* are shown in misalignment.



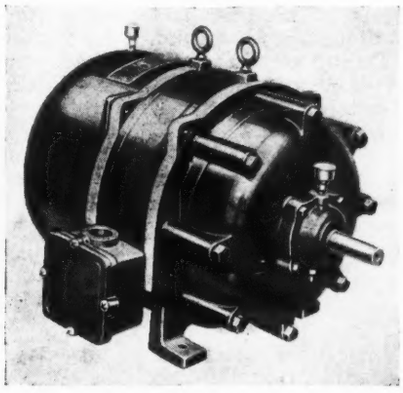
Francke cross-type coupling shown with the shafts misaligned

It is pointed out by the manufacturers that this coupling handles center misalignment because it maintains large evenly loaded and well-lubricated bearing areas unchanged under all operating conditions. It also provides small resistance to endwise float and handles a limited amount of angularity.

The coupling is put out in four sizes, with maximum bore diameters from $1\frac{1}{8}$ to $1\frac{7}{8}$ in. and with rating of $1\frac{1}{2}$ to $7\frac{1}{2}$ hp. at 850 r.p.m., 2 to 10 hp. at 150 r.p.m. and 3 to 15 hp. at 1,750 revolutions per minute.

Totally Inclosed Motor for Use in Hazardous Locations

A TOTALLY inclosed motor designed especially for use in gasoline vapor and other explosive atmospheres coming under Class 1 Group D has been brought out by Howell Electric Motor Company, Howell, Mich.



Totally inclosed motor for Class 1, Group D locations

It is built in either polyphase or single-phase design, with a totally inclosed frame or a totally inclosed fan-cooled frame. The polyphase motors are of squirrel-cage construction, with extra heavy castings, bolts and parts. All machined parts have large fitting surfaces to meet the Underwriters' Laboratory requirements.

The single-phase motors are also of squirrel-cage construction and of the condenser-start type, each motor having a condenser starting unit placed in a separate box which must be outside the hazardous area.

Inclined Water Gage With Tubular Brace

IN THE inclined water gage mounting illustrated, whether for high-pressure round or flat glass, an inclined tubular brace forms a steam and a water connection between the upper and lower mountings, as shown.

It is pointed out by the manufacturer, the Wright-Austin Company, 2231 Park Ave., Detroit, Mich., that the equalized temperature which results from the steam and water in the tubular brace tends to remove all strain from the gage glass and prevent distortion due to unequal expansion and contraction. This, in turn, materially lengthens the life of the gage glass.

Tubular brace between fittings takes strain off gage glass

Wire Rope of Stainless Steel

IN ADDITION to resisting chemicals, salt water and salt air corrosion, the wire rope of chrome nickel alloy steel now being put out by the Hazard Wire Rope Company, Wilkes-Barre, Pa., under the name of "Korodless," can, it is claimed, be safely operated in temperatures up to 1,650 degrees.

As in other types of wire rope made by the company, performed construction is used, the stands and wires being helically shaped to the exact form they assume in the rope structure. This construction, it is claimed eliminates internal stress and allows the individual wires to lie side by side without undue internal friction, thus materially increasing the life of the rope. Standard sizes are available.

NEWS of the FIELD

Plans Completed for Power Exchange Between Niagara Hudson and N. Y. Edison Companies

Work to start at once on transmission line linking vast steam and hydro-electric systems

FINAL PLANS for an interconnection to take care of the exchange of power between the steam generating system of the New York Edison Company and the hydro-electric system of the Niagara Hudson Power Corporation were completed on March 9. Work will begin at once on the construction of a 110,000-volt transmission line linking the two systems, and it is expected that the first interchange of power will be made late this year.

Definite action on the interconnection, foreshadowed on Feb. 17 when Floyd L. Carlisle, who is chairman of the Niagara Hudson Power Corporation, also became chairman of the New York Edison Company, was taken sooner than anticipated in financial circles, according to press reports, and it is expected to result during the next few months in a closer financial affiliation between the two groups.

According to the plans announced Niagara Hudson is to build a 110,000-volt transmission line from its Greenbush substation, south of Albany, to Poughkeepsie, where it will connect with a 132,000-volt line running to the Dunwoodie substation of the Edison system in Yonkers. Two 132,000-volt lines already link the Dunwoodie substation with the main power plants of the Edison system, and the Greenbush substation also is connected with a system of power lines stretching from Niagara Falls to the Massachusetts State line.

Development of the St. Lawrence will result in the construction of further high-tension lines in the northern section of the state connecting with the main Niagara Falls-Hudson Valley transmission system.

The entire system is based upon an interconnection of steam generating stations and hydro-electric stations, so that coal and water power may share the burden and guarantee operation whatever conditions of drought or coal shortage may exist at a given time. As a result of economies effected in operation, the connection is expected to bring about lower rates for consumers in New York City and other parts of the state.

In effect, the plan to link Niagara Hudson and New York Edison is based on the northern company's work in harnessing a further part of the 1,000,000 hp. available in the Upper Hudson Valley. The construction of the Sacandaga Dam, which will supply water for the Conklingville station immediately below the dam, also will control water flow for the benefit of other power sites located downstream on the Hudson.

Considerable surplus power is available in the Niagara Hudson system due to the impounding of water in the storage reservoirs in the headwaters of the rivers of northern and eastern New York throughout the high-water months.

During certain months of the year, on the other hand, the New York Edison system has surplus steam generating capacity which can be utilized economically by Niagara Hudson. Last summer, for instance, such an arrangement would have been of great value when northern and eastern New York were suffering from the drought.

New Mercury and Steam Units for Kearny Plant

A 20,000-KW. MERCURY-VAPOR UNIT will be installed in the Kearny station of the Public Service Corporation of New Jersey in time for service in 1932, according to a recent announcement of the company. In addition, a 75,000-kw. turbine-generator will be added to the present installation at Kearny, also for use next year, it is stated. These two new units will increase the capacity of the station from 214,500 to 309,500 kilowatts.

The mercury-vapor boiler and turbine will have the same rating as the one now being built by the General Electric Company at Schenectady, N. Y., for its own use jointly with use under lease by the New York Power & Light Corporation and will be twice the size of the mercury-vapor installation in the South Meadow plant of the Hartford Electric Light Company. Decision to install the innovation at Kearny, the Public Service company states, was made after an exhaustive analysis of the performance of the Hartford unit and in the belief that it promises greater efficiency in the generation of power at the station.

Other plans of the company include the addition of a 15,000-kw. high-pressure exhaust turbine and the necessary boiler equipment to the Burlington station in the southern part of the territory. This will be done next year. Eventually 225,000 kw. in new equipment may be installed on land acquired next to the Burlington plant.

Engineers Fight Steam Plant Inspection Bill

INDIVIDUALLY and collectively engineers in New York are fighting the passage of the Miller-Kelly bill, now before the legislature, which aims at drastic supervision by the state Department of Labor of all existing and future steam power and heating plants, whether in public or private buildings, and provides for the registration of all master steam fitters. (See *Power,* March 3, p. 385.)

The measure is still in committee, and protests against it are being sent to Senator John W. Gates, chairman of the Labor and Industries Committee, Senate Chamber, State Capitol, Albany, N. Y., and Assemblyman Charles P. Miller, chairman of the Labor and Industries Committee, Assembly Chamber, State Capitol, Albany, N. Y. The American Society of Heating & Ventilating Engineers is taking a prominent part in the fight against the bill and urges all those opposed to it to address their protests to Senator Gates and Assemblyman Miller.

London Smoke-Abatement Law Passed as Amended

THE MODIFIED DRAFT of the smoke-abatement by-law for London County, England, has recently been passed by the county council. As approved, the act provides for regulation of the smoke nuisance in both industrial plants and central stations, allowing exemption to all process industries exempted in other areas of the country. It further pro-

vides that the period before the regulation covering the two-minute emission of smoke becomes operative is five years. Taking into consideration the time before the by-law would go into effect, this means that almost a six year period of grace is given firms in which to introduce modification in fuel consumption control so as to conform with the requirements of the new law.

As reported in *Power* of Jan. 20 (p. 125), the by-law as originally drafted applied to every class of industry. It would have entailed heavy expense, and in some cases a complete redesigning of industrial power plants in the area covered by the council. Because of protests of certain industrialists, the council agreed to amend the bill and passed it in the present modified form.

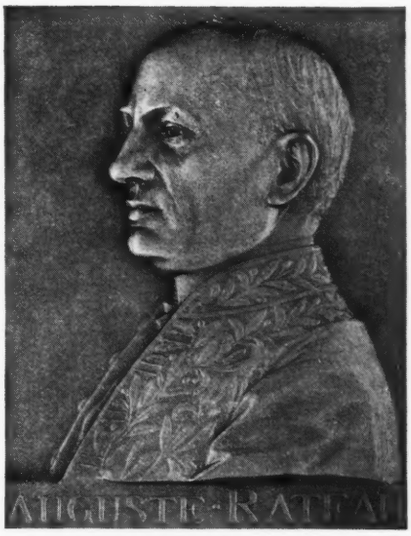
New York Bill Would License All Welders

A BILL to amend the general business law in relation to the licensing of mechanic welders was introduced in the New York State Legislature last week by Assemblyman Zimmerman. It provides for the establishment of a division of mechanic welders in the department of state, the head of which shall be a board of six members appointed by the governor. One member of the board shall be a constructing or welding engineer, one member a chemical engineer, two members shall be gas welders, and two electric welders. Every member must have had five years' experience and be actively engaged in his profession or trade at the time of appointment. This board shall carry out the regulations governing the licensing of mechanic welders.

If passed the act will go into effect on July 1, 1931, and within 60 days after that date "every person engaged in this state in the trade or calling of a mechanic welder, upon presenting satisfactory evidence to the board that he is engaged as such mechanic welder upon a verified application blank to be furnished by the board and the payment of a license fee of ten dollars, shall be entitled to be registered as a mechanic welder for the period of one year from the date of approval of such application. . . . Upon the expiration of the term thereof the license may be renewed annually from time to time on the payment of a renewal fee of two dollars." After Sept. 1, 1931, "an examination will be required to obtain a license, and no one will be allowed to engage in the trade without a license.

In addition to those working as mechanic welders, "every member of a firm and every officer of a corporation proposing to engage in the trade or calling of a mechanic welder shall first procure a license," the only exceptions being those engaged in the manufacture, production, or repair of welding apparatus and registered chemical, constructing, and welding engineers.

AUGUSTE RATEAU HONORED



To commemorate the scientific achievements of Auguste C. E. Rateau, eminent French engineer, inventor, and pioneer investigator in the steam-turbine and turbine-compressor fields, who died last year, the Société Rateau has had struck off this bronze portrait medallion, executed by G. Prud'homme. The medallion illustrated was recently presented to the American Society of Mechanical Engineers, of which Professor Rateau was an honorary member

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Seattle Mayor Dismisses J. D. Ross, Supt. of Lighting Dept.

A SENSATION WAS CAUSED in political and power circles in Seattle, Wash., on March 9 by the news that J. D. Ross, superintendent of the municipal lighting department and known as the father of the Skagit River hydroelectric project, had been summarily discharged by the Mayor of the city, Frank Edwards. Mayor Edwards alleged as the reason for this action that Mr. Ross had been inefficient, disloyal to the city's best interests, extravagant and wasteful in the use of public funds and had failed to co-operate with the Board of Public Works, the City Council and the city's executive head. The Mayor subsequently named A. F. Marion, chief engineer of the Pacific Coast Company, to succeed Mr. Ross, but this appointment must be approved by a two-thirds vote in the council before becoming effective.

The Mayor's action was taken on the eve of a city election, held on March 10, in which the dominant issue was an amendment, sponsored by Superintendent Ross and opposed by the Mayor, to permit the city light department to set up and maintain its own engineering department. This amendment carried by 27,890 to 25,911, and the entire council slate opposing Ross was defeated. As a result talk of a recall of the Mayor is heard.

Mr. Ross, who enjoys well-earned prominence among municipal-plant executives and engineers, had been with the department, of which he is regarded as the founder, for 26 years. He denies the Mayor's allegations and says that his discharge was due to politics.

Loeffler Boilers Ordered For Czechoslovakian Plant

THREE LOEFFLER BOILERS, each with a designed output of 150,000 lb. of steam per hour, at 1,850 lb. pressure and 932 deg. F. temperature, have been ordered for a new central power station to be built in the Ostrau-Karwiner district of Czechoslovakia. According to the announcement in the Feb. 13 issue of *The Engineer* (London) this station will be jointly owned by three utility corporations, and will serve for generating and peak-load purposes. The initial installation will be 42,000 kw., with provision for later extension to 160,000 or 200,000 kw. The high-pressure installation is to be completed in 1932.

The Engineer states that the decision to use the Loeffler high-pressure system of steam generation resulted from the economical and reliable operation of the boilers at the Vienna Locomotive Works in Florisdorf and at the Karolinen Mine of the Witkowitz Coal Company. The boilers will be furnished by the Witkowitz Iron Works.

The Loeffler boiler, as described and discussed previously in *Power*, is actually a direct-fired superheater with economizer. The superheated steam is bubbled through water in a drum, producing additional saturated steam. The whole is then returned to the superheater tube by a pump. In this system all direct-fired water-heating surfaces (except economizer) are eliminated.

Minority Bill Submitted On St. Lawrence Project

FORMER Lieutenant Governor Thomas M. Conway, of New York, dissenting member of the St. Lawrence Power Development Commission, submitted to Governor Roosevelt and the majority leaders of the legislature on March 11 his own bill for the creation of a water-power authority to develop the hydroelectric resources of the St. Lawrence.

Mr. Conway's bill differs from the bill submitted by the majority members of the commission in that it authorizes the trustees of the proposed water-power authority to build its own transmission lines for the distribution of the state power in the event that a suitable contract cannot be made with an existing utility for the sale and distribution of the power. Provisions of the majority bill were reported last week in *Power* (p. 421).

Byllesby Engineering Convention Next Week

H. W. FULLER, vice-president in charge of engineering and construction, Byllesby Engineering and Management Corporation, announces that the sixth annual convention of the company's engineering department will be held March 24 and 25 in the Bal Tabarin of the Hotel Sherman in Chicago. The convention sessions will be presided over by Mr. Fuller, and speakers will include John J. O'Brien, president of the company, and R. J. Graf, first vice-president, together with others presenting technical discussions concerning the various phases of the company's engineering and construction operations.

The annual convention dinner will be held Wednesday evening, March 25, at the Sherman when the principal speakers will be G. E. Mason, Chicago attorney, who will discuss "Observations of a Traveler in Russia," and E. L. Manning, of the General Electric research department, who will talk on "Gulliver's Travels Among the Real Lilliputians of the Universe."

Obituary

HARRY J. HUNSICKER, mechanical and civil engineer of the New York Power & Light Corporation and one of the builders of the original Spier Falls hydro-electric station on the Hudson River, near Glens Falls, N. Y., died on March 6 at his home in Albany, N. Y., after an illness of only two days. He was 51 years old. Mr. Hunsicker began his career with what has become the New York Power & Light Corporation in 1903, when he was assigned to Glens Falls to assist in the construction of the first plant at Spier Falls, which was nearing completion. At that time the company was known as the Hudson River Water Power Company. He was sent to Amsterdam in 1920 and since 1928 had been located at the main office in Albany. He was a member of the American Institute of Electrical Engineers and the N.E.L.A.

HARVEY D. WILLIAMS, formerly attached to the Bureau of Steam Engineering of the Navy Department and inventor of the hydraulic variable-speed transmission used for operating gun turrets, died March 9 at the Meriden (Conn.) Hospital. Mr. Williams, who was born in Shaftsbury, Vt., in 1864, became a draftsman for the Yale & Towne Manufacturing Company, of Stamford, Conn., after he was graduated from Stevens Institute of Technology in 1885. For ten years, beginning in 1888, he was a member of the engineering faculty at Cornell University and in 1899 he joined the Bureau of Steam Engineering of the Navy Department. Four years later he became an engineer in the Naval Bureau of Ordnance, where he remained until 1911, when he became construction engineer of the Waterbury Tool Company, Waterbury, Conn. He was a member of the American Society of Mechanical Engineers and a fellow of the American Association for Advancement of Science.

COMING CONVENTIONS

American Society of Mechanical Engineers. Semi-annual meeting in Birmingham, Ala., Apr. 20-23. Meeting at Hartford, Conn., June 1-3. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 15-16. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meeting in Rochester, N. Y., Apr. 29-May 2. Annual summer convention in Asheville, N. C., June 22-26. District meeting at Lake Tahoe, Calif., Aug. 25-28. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Refrigerating Engineers. Spring meeting at the Hotel President, Kansas City, Mo., May 6-8. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting in New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York City.

American Refractories Institute. Annual spring meeting at The Greenbrier, White Sulphur Springs, W. Va., May 18-19. Secretary, Dorothy A. Texter, Oliver Building, Pittsburgh, Pa.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

1931 Midwest Bituminous Coal Conference. To be held at the University of Illinois, Urbana, Ill., May 21-22. Chairman of Program Committee, B. R. Gebhart, Illinois Coal Bureau, 307 North Michigan Ave., Chicago, Ill.

National Association of Power Engineers. Annual convention and mechanical exposition in the Convention Hall, Kansas City, Mo., Sept. 7-11. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago, Ill.

National District Heating Association. Annual convention at the Hotel Statler, Boston, Mass., June 2-5. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Sherman Hotel, Chicago, Ill., Aug. 4-8. Secretary of Convention Committee, James J. Blaine, 7342 Harvard Ave., Chicago, Ill.

Personals

DR. JOHN ALEXANDER LOW WADDELL, eminent bridge engineer, has been awarded the Clausen gold medal by the American Association of Engineers for his "distinguished service in promoting the social and economic welfare of the enginering profession." Presentation of the medal was made on March 11 at a dinner of the association, held at the Hotel Astor in New York City. Founded in 1926, this is the first time the Clausen medal has been awarded.

GEORGE W. MARTIN, for many years consultant on the design and operation of steam power and heating plants, has recently been appointed supervising engineer of the United States Realty & Improvement Company of New York City. He will supervise the operation of mechanical and electrical equipment in the properties of the company.

REAR ADMIRAL H. E. YARNELL, chief of the Bureau of Engineering of the United States Navy in Washington, D. C., will be relieved of this duty on or about May 29 to become Commander of Aircraft of the United States Fleet. Captain S. M. ROBINSON, who is now on duty at Puget Sound, Wash., will succeed Admiral Yarnell as chief of the Bureau of Engineering.

O. C. MERRILL, chairman of the American Committee of the World Power Conference, is recovering from a major operation at the Emergency Hospital in Washington, D. C.

R. C. DENNY, for many years with the Combustion Engineering Corporation, has become associated with the M. H. Detrick Company, as consulting engineer with headquarters in Chicago, Ill.

MANNE T. LINDHAGEN, managing director of Ljungströms Steam Turbines, Inc., of Stockholm, Sweden, arrived in New York City on March 4 for a month's visit to this country.

E. A. TRAFZER, formerly with the Celite Products Company and the Johns-Manville Corporation in the Los Angeles, Calif., district, is now associated with the Paraffine Companies, Inc., with headquarters at San Francisco.

WALTER W. COOPER has been employed by the California Railroad Commission to take charge generally of the preparation of cases before the commission, the employment to commence as soon as Mr. Cooper can bring to a close his existing engagements with various California cities, by whom he is employed in rate matters.

EDWARD E. WHEELER and DAN S. JONES were appointed members of the Colorado Public Utilities Commission by Governor Adams last month. Both appointees are former state senators, and their appointments have been confirmed by the senate.

Business Notes

ILLINOIS TESTING LABORATORIES, INC., Chicago, Ill., announce the appointment of Ernest H. Du Vivier, 30 Church St., New York City, as their representative in metropolitan New York and northern New Jersey, and the appointment of F. W. Fernald, 335 Fifth Ave., Pittsburgh, Pa., as their representative in western Pennsylvania and West Virginia.

HENSZEY DE-CONCENTRATOR COMPANY, Watertown, Wis., announces the appointment of Leo J. Schaedle, 950 Dierks Building, Kansas City, Mo., as sales representative for that territory.

LEE B. METTLER COMPANY, Los Angeles, Calif., announces the appointment of W. R. Brown as its representative in Texas and Louisiana. During the past two years Mr. Brown has been representing the Roberts-Gordon Appliance Corporation in Ohio, West Virginia, and Kentucky.

PATRON GENERAL CONTRACTING COMPANY, New York City, announces the acquisition of the business and plant of the J. T. DILL COMPANY of that city, for the past 60 years manufacturers of belting, shafting and hangers.

THE RIC-WIL COMPANY, Cleveland, Ohio, announces the appointment of the following new sales agents: H. H. Wright, 615 City Bank Building, Kansas City, Mo.; J. M. O'Connor, 1100 East Douglass St., Wichita, Kan.; B. R. Hawley, 724 Union State Bank Building, Omaha, Neb.; and the Frank Loeffler Supply Company, 710 North Hudson St., Oklahoma City, Okla.

How's Business?

CURRENT CHANGES in industrial activity and trade volume are still indecisive as to spring business prospects. Bonus payments and other early March financial transactions have increased money turnover; steel production continues its slow seasonal rise in contrast to last year; and spring commercial loan expansion has begun. Our index, up slightly to 79 per cent of normal, is still at about the average level of the past two months. The first year-to-year upturn in residential building since its long decline began in 1928, some seasonal improvement in employment, a flattening of the commodity price curve paralleling last year, a better bond market and favorable crop prospects are the main straws of domestic cheer. — *The Business Week*, March 18.

WITH THE SOCIETY SECTIONS

A.S.M.E., Anthracite-Lehigh Valley Section. Meeting and exhibition at the Hotel Altamont, Hazelton, Pa., on Saturday afternoon and evening, April 18. General subject: "Practical Industrial Lubrication." A large number of manufacturers are expected to exhibit small lubricating devices and equipment. Manager, C. W. Bell, 177 East Broad St., Hazelton, Pa.

A.S.M.E., Philadelphia Section. Meeting at the Engineers' Club on March 24 at 8 p.m. Subject: "Design, Construction, and Operation of Mercury-Vapor Generating Units," B. P. Coulson, Jr., and H. N. Hackett, General Electric Company.

A.S.M.E., Syracuse Section. Meeting at the Onondaga Hotel roof garden on March 30 at 8 p.m. Subject: "Some Phases of the Present Economic Situation as It Pertains to Unemployment," by Ralph E. Flanders, Jones & Lamson Machine Tool Company.

A.S.R.E., Boston Section. Meeting at the Massachusetts Institute of Technology on March 26. Subjects: "Corrosion," by Professor H. O. Forrest, M.I.T.; and "Flaked Ice," by Crosbie Field, Flake Ice Corporation. The meeting will be preceded by a dinner at the Riverbank Court Hotel.

Trade Catalogs

TUBING—Complete engineering data, as well as data taken from actual operating records, on Nirosta KA2 seamless tubes and pipe is presented in a recent publication of the Babcock & Wilcox Tube Company, Beaver Falls, Pa. This is the second edition of the company's booklet on the subject and contains much new information on the physical properties and applications of Nirosta KA2, together with many illustrations.

STOKERS—An illustrated description of "Firite" stokers adapted to boilers of from 700 to 7,000 sq.ft. of heating surface, is contained in a new catalog issued by the Hoffman Combustion Engineering Company of Detroit, Mich. Line drawings show the application of this stoker to many types of boiler installations.

AIR CONDITIONING—Bulletin No. 378 of the B. F. Sturtevant Company, Hyde Park, Boston, Mass., describes the company's "Filticooler," a new unit for washing and conditioning air. Tables of physical data and performance are included in the publication.

SPEED REDUCERS—A line of small worm-gear speed reducers, applicable to horsepower ratings from 5.4 downward, are described and illustrated in a new bulletin issued by the Horsburgh & Scott Company, Cleveland, Ohio.

COAL AND ASH HANDLING—Bulletin No. 1237 just issued by the Atlas Car & Manufacturing Company, Cleveland, Ohio, describes and illustrates electric locomotives, cars, weigh larries, and accessories for handling coal and ashes around central stations and industrial power plants.

COMPRESSORS—Features of the Pennsylvania method of "dual compressor control" are described and illustrated in General Bulletin No. 102 just issued by the Pennsylvania Pump & Compressor Company, Easton, Pa.

ASH CONVEYORS—An illustrated description of the operation, applications, and advantages of the "Nuveyor" heavy-duty ash-conveying system is contained in a new catalog of the United Conveyor Corporation, Old Colony Building, Chicago, Ill.

Fuel Prices

FUEL OIL

New York—March 12, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, contract, 6c. per gal.

St. Louis—March 7, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.445 per bbl.; 28@30 deg., $1.545 per bbl.; 30@32 deg., $1.645 per bbl.; 32@36 deg., gas oil, 3.551c. per gal.; 38@40 deg., distillate, 4.276c. per gal.

Pittsburgh—March 4, f.o.b. local refinery, 34@36 deg., fuel oil, 3.125c@3.5c. per gal.; 36@40 deg., 3.125c.@3.5c.

Philadelphia—March 11, No. 4, light, $1.31 per bbl.; No. 5, medium, $1.22; No. 6, heavy (Bunker C), $1.10.

Cincinnati—March 10, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—March 4, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 53.75c. per bbl.; 22@26 deg., 62.5c. per bbl.; 26@28 deg., 72.5c. per bbl.; 28@30 deg., 83.75c. per bbl.

Boston—March 9, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.95c. per gal.; 28@32 deg., 4.95c. per gal.

Dallas—March 7, f.o.b. local refinery 24@26 deg., $1.05 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.90 @ $2.25
Pool 10, h. gr. low-vol.	New York	1.75 @ 1.85
Pool 11, low-vol.	New York	1.60 @ 1.75
Smokeless, mine-run	Chicago	1.75 @ 2.00
Smokeless, slack	Chicago	.75 @ 1.35
Harlan, Ky., slack	Chicago	.70 @ 1.00
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.50 @ 1.60
Ind. 5th Vein, m.-r.	Chicago	1.20 @ 1.75
Standard Ill., mine-run	St. Louis	1.50
W. Ky., mine-run	Louisville	.90 @ 1.25
W. Ky., slack	Louisville	.60 @ .85
Pittsburgh, mine-run	Pittsburgh	1.35 @ 1.45
Smokeless, mine-run	Cincinnati	1.75 @ 2.00
Smokeless, slack	Cincinnati	1.10
Kanawha, mine-run	Cincinnati	1.10
Kanawha, nut-slack	Cincinnati	.60 @ .85
Anthracite (Gross Tons)	**At Mine, for Shipment to**	**Price per Ton**
Buckwheat	New York	$3.50
Barley	New York	1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ariz., Tucson—Tucson Gas, Electric Light & Power Co., has work under way on two 4,000 hp. Diesel engine plants, enlargement of power plant, cooling tower, etc. Estimated cost $500,000. S. Headman, is engineer. Part of work will be done by individual contracts and part by day labor.

Calif., Sacramento — H. Mitau, 1422 40th St., awarded contract for a 16 story office building at 8th and J Sts., to Lindgren and Swinerton Inc., California State Life Bldg. Estimated cost $800,000.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., awarded masonry contract for a 3 story, 38 x 134 ft. addition to service building at 2201-09 Throop St. Estimated cost $45,000.

Ind., Washington—City awarded contract for improvements to municipal electric light plant to Kretz & Zinkan, Washington. Estimated cost $25,000.

Ind., West Lafayette—Purdue University, R. B. Stewart, Comptroller, will receive bids end of March for the construction of a power plant. Estimated cost $1,000,000. W. Scholer, 210 Wallace Bldg., Lafayette, is engineer. Equipment including boilers, etc., will be required.

Ky., Columbia—City awarded contract for the construction of a complete waterworks system including filter plant, pump house, etc., to Pittsburgh-Des Moines Steel Co., 38 South Dearborn St., Chicago, Ill.

Ky., Mount Sterling—City plans the construction of a power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., is engineer.

Mass., Andover—Town appropriated $15,000 for waterworks improvements including purchase of electric driven pump, etc. Private plans.

Mass., Boston—Edison Electric Illuminating Co., 39 Boylston St., awarded contract for foundation for addition to steam heating plant at Kneeland and Utica Sts. to Gow & Co., Park Sq. Bldg. Estimated cost $40,000.

Mass., Reading—Electric Light & Power Dept., 177 Main St., plans addition to power plant and switchboard room on Ash St. Estimated cost $45,000. Engineer not announced.

Mass., Wakefield—Water Board, c/o S. F. Adams, 128 Pleasant St., plans driven wells and pumping station in connection with waterworks. Weston & Sampson, 14 Beacon St., Boston, are engineers. This corrects reports published in Feb. 10 issue.

Minn., Redwood Falls—City will soon receive bids for waterworks improvements including reservoir softening plant, pump house, pumping equipment, etc. Estimated cost $15,000. L. P. Wolff, 903 Globe Bldg., St. Paul, is engineer.

Nev., Las Vegas—Dept. of Interior, Bureau of Reclamation, Wilda Bldg., 1441 Walton St., Denver, Colo., awarded contract for the construction of Hoover dam (Boulder dam project) including power plant, etc., in the upper Black Canyon on the Colorado River, 30 mi. southeast of Las Vegas on the Arizona-Nevada-California state lines to Six Companies Incorporated, composed of Utah Construction Co.; Morrison & Knudsen; McDonald & Kahn; J. F. Shea Co.; Kaiser Paving Co. and Bechtel Construction Co., 526 Phelan Bldg., San Francisco, Calif. $48,890,995.

New York—New York Power & Light Co., subsidiary of Niagara Hudson Power Corp., 15 Broad St., and New York Edison Co., Irving Pl., New York, is having plans prepared for the construction of two 110,000 v. high voltage power lines from Yonkers to Poughkeepsie. Estimated cost approximately $10,000,000.

N. Y., Brooklyn—Williamsburg Ice Co., 257 Ten Eyck St., awarded contract for addition and alternations to ice manufacturing plant, at Ten Eyck St. and Bushwick Ave. to Cooling Tower Co., 15 John St., New York.

N. Y., New York—Dept. of Correction, R. C. Patterson, Jr., Comr., Municipal Bldg., awarded contract for power plant and electrical work at Rickers Island Penitentiary, East River to Erickson Equipment Co., Grand Central Terminal, $785,000.

N. Y., New York—Museum of Science & Industry of New York, 220 East 42nd St., plans the construction of an office building and tower at Grand Central Zone. Estimated cost $10,000,000. Maturity indefinite.

N. Y., New York—U. S. Trust Co. and Bankers Trust Co., awarded contract for the construction of a bank and office building at Wall and Nassau Sts. to Thompson-Starrett Co., 250 Park Ave. Estimated cost $5,500,000.

N. Y., Rockaway Beach—Queensboro Gas & Electric Co., 1610 Central Ave., Long Island City, plans the construction of a 37 x 59 ft. gas generator plant at Beach Channel Dr. and Beach 108th St. here. Estimated cost $40,000. C. L. Phillip & Co., c/o owner, are architects.

O., Cincinnati — Hamilton County Commissioners, Court House, awarded contract for a 6 story, hospital on Guerley Rd. to Hodges Construction Co., Chamber of Commerce Bldg. Estimated cost $663,000.

O., Cleveland—Bd. of County Commissioners, F. J. Husak, Clk., is having plans prepared for the construction of a group of buildings for detention home including steam heating and refrigeration systems, boilers, elevators, etc. at East 22nd St. and Central Ave. Estimated cost $1,850,000. F. W. Bail, Hanna Bldg., is architect.

O., Franklin—City is having plans prepared for the construction of a power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., is engineer.

Pa., Oakmont—Duquesne Light Co., 435 6th Ave., Pittsburgh, has work under way on the construction of a sub-station at Hulton Rd. and Allegheny Ave. Estimated cost $150,000. Byllesby Engineering & Management Corp., 435 6th Ave., Pittsburgh, are contractors.

R. I., Newport—City is having plans prepared for the construction of a sewerage system including two pumping stations, etc. at Broadway and Spring St. Estimated cost $185,000. Private plans. Address J. A. Openshaw, Commissioner of Public Works, City Hall.

R. I., Newport—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans improvements to power plant and distribution system at Naval Training Station here. Estimated cost $30,000. Work will be done by owner's forces.

Tex., Point Isabel — City, c/o G. Scanland, Mayor, will receive bids about Mar. 28 for the construction of a waterworks system, including distribution system, pumping unit, etc. Estimated cost $75,000. H. E. Elrod, Houston, is engineer.

Wash., Seattle—V. W. Voorhees, Lloyd Bldg., Archt., will receive bids about June 1 for the construction of a 2 story, 180 x 256 ft. laundry including power plant at 11th and Marion Sts., for Empire Laundry, 2301 Western Ave. Estimated cost $200,000.

B. C., Vancouver—City awarded contract for a 1 story, 160 x 380 ft. exhibition building and ice rink to Snider Construction Co. Ltd., 637 Granville St. $103,444. Heating and refrigeration systems for ice rink will be awarded later.

Ont., Goderich—Huron County Fruit Growers Association, plans a 4 story fruit packing and cold storage plant. Estimated cost $100,000. E. H. Darling, 36 James St. S., Hamilton, is engineer. Complete equipment will be required.

Ont., Hamilton—Royal Connaught Hotel Co., King St. E., awarded contract for the construction of 14 story addition to hotel to Pigott Construction Co. Ltd., Pigott Bldg. Estimated cost $1,000,000. Steam heating system, etc. will be installed.

Ont., Merritton—Dept. of Railways & Canals, Ottawa, awarded contract for the installation of surge tank, penstock, breeching and connections for hydro-electric power plant at Welland Canal here, to Horton Steel Works Ltd., Bridgeburg. Estimated cost $103,104.

Ont., Toronto — Merchandise Mart Syndicate, 204 Imperial Bank Bldg., 53 King St. W., plans the construction of a 21 story merchandise mart including steam heating system, elevators, etc. at York and Fleet Sts. Estimated cost $3,000,000 or more. E. G. Bird, 53 King St. W., is architect.

Que., Montreal—Notre Dame Hospital, Sherbrooke St., will soon award contract for the construction of a power plant, laundry building, etc. Estimated cost $180,000. L. A. and P. C. Amos, 1414 Crescent St., are architects.

Equipment Wanted

Conveyor—Gardner, Mass.—Gardner Pad Co., plans to purchase a 150 ft. conveyor or belt, 16-24 in. wide.

Engine and Generator — Pawhuska, Okla. — City plans to purchase one 750 hp. Diesel engine and generator.

Pumps—Lorain, O.—City plans the installation of two electrically driven auxiliary pumps, etc., in connection with proposed waterworks. Estimated cost $250,000 to $300,000.

Pumps — Galveston, Tex. — City, c/o J. E. Pearce, will readvertise for bids soon for new water pump at Alta Roma station. Former bids rejected.

Pumps, Engine, etc.—Ottawa, Ont.—Bd. of Control, will soon receive bids for three 17 m.g.p.d. electric pumping units, also 400 hp. Diesel oil engine capable of working pumps to a capacity of 35 m.g.d. in connection with waterworks.

Industrial Projects

Calif., Maywood—Jaeger Furniture Mfg. Co., 6000 South Boyle Ave., Huntington Park, awarded contract for the construction of a 1 story factory on East Slauson Ave. here to W. J. Moran, 324 West 48th St., Los Angeles. Estimated cost to exceed $60,000.

Calif., Oakland—Owens-Illinois Glass Co., W. I. Cole, Mgr., 133 Kearny St., San Francisco, is having plans prepared for a glass factory here. Estimated cost $1,000,000. Private plans.

Calif., Sausalito—Enterprise Boat Building Co., 1355 Bush St., San Francisco, plans the construction of a 2 story boat building plant here. Estimated cost $40,000. Architect not selected.

N. J., Newark—Weldon Roberts Rubber Co., 18 Oliver St., will not construct 2 story addition to factory at 361-65 6th Ave. Estimated cost $40,000. M. N. Shoemaker, 10 Bleecker St., Archt. Project abandoned.

N. Y., Jamaica—Aluminate Co., 135-26 Hillside Ave., is having preliminary plans prepared for the construction of a manufacturing plant at 132nd St. and 91st Ave. Estimated cost $40,000. H. J. Jeffrey, Jr., 90-50 Parsons Blvd., is architect.

N. J., Paterson—Canova & Simons Silk Co., 182 Cedar St., will soon award contract for the construction of a silk mill. Estimated cost to exceed $40,000. Lockwood Greene Engineers Inc., Pershing Sq., New York, N. Y., are engineers.

N. Y., Brooklyn—Empire State Bag Co., 760 Wythe Ave., awarded contract for addition and alterations to factory at Penn St. and Wythe Ave. to William Rieger Construction Co., 451 West 54th St., New York. Estimated cost $40,000.

N. Y., Fairport—Trescott Co., awarded contract for the construction of a 1 story 60 x 120 ft. factory to C. M. Lombard, Fairport. Estimated cost $40,000.

O., Akron—Anderson Rubber Co., 124 North Union St., awarded contract for the construction of a 2 story, 74 x 109 ft. factory for the manufacture of rubber balloons and specialties, to Krumroy Construction Co., 225 West Exchange St. Estimated cost $50,000. Maturity June 1.

O., Cleveland—Industrial Rayon Corp., H. S. Rivitz, Pres., West 98th St. and Walford Ave., manufacturers of viscose wrapping paper, plans the construction of a factory on Walford Ave. Estimated cost to exceed $50,000. Christian, Schwarzenberg & Gaede, 1836 Euclid Ave., are architects and engineers.

O., Dayton—Hohman Plating Co., 815 East 5th St., is having sketches made for the construction of a 3 story factory at Second and Taylor Sts. Estimated cost $100,000. W. J. Huhn, 204 McClure St., is architect.

Pa., Pittsburgh—Mayer Body Corp., W. G. Mayer, 6459 Frankstown Ave., will soon award contract for two additions to plant, 1 story, 30 x 100 ft. and 2 story, 50 x 100 ft. at 6461 Frankstown Ave. Lake & Davidson, Negley Bldg., are architects.

Tex., Altman — Apache Refining Co., Los Angeles, Calif., will build a 30,000,000 cu.ft. gasoline extraction plant, 5,000 bbl. capacity, near here. Estimated cost $200,000. Private plans. Most of work will be done by owner's forces.

Tex., Longview — Southern Oil Refining Co., El Dorado, Ark., is having preliminary plans prepared for the construction of an oil and by-products refinery here. Estimated cost $125,000. Private plans.

Wash., Seattle—Bates Valve Bag Co., R. S. Brown, Mgr., Pacific Northwest Bldg., will soon receive bids for a 1 story factory for the manufacture of heavy duty paper bags for packing cement, lime, etc. 150,000 bags daily capacity, at 625 West Spokane St. Estimated cost $80,000.

Wash., Seattle — Pacific Coast Steel Co., Youngstown Pl., plans the construction of a 1 story, 88 x 400 ft. warehouse at 4001 28th St. S. W. Estimated cost $40,000. Private plans.

Man., Winnipeg—Winnipeg Heating Co. Ltd., plans addition to plant. Estimated cost $1,000,000.

Ont., Copperclife—International Nickel Co., awarded contract for a precious metals separation plant to Fraser-Brace Engineering Co., 107 Craig St. W., Montreal, Que. Estimated cost $1,000,000.